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NUTRITION PLUS
NEWSLETTER

IN THIS **ISSUE**

NEW RESEARCH ON NULLIPAROUS COWS AND NEGATIVE DCAD DIETS

Most research evaluating diets with negative DCAD for prepartum cows has been done with multiparous cows. Given that multiparous cows have a greater incidence of hypocalcemia and other postpartum diseases that seems logical. However, nulliparous cows, also called first-calf heifers, represent approximately 30 to 40% of cows in the prepartum pen on most dairies. And on many farms nulliparous and multiparous cows share the same pen and diet prepartum. That means nulliparous cows are fed negative DCAD diets without fully understanding the benefits or the potential negatives.

Nulliparous cows may indeed benefit from negative DCAD diets prepartum. But it could also be that feeding acidogenic diets, especially an excessively acidogenic diet, could result in reduced postpartum performance. Data with nulliparous cows is scarce, explains José Santos, professor of dairy cattle nutrition and reproduction at the University of Florida. So that answer remains unclear. The two recent meta-analyses (Lean et al., 2019 and Santos et al., 2019) only contained data on 151 nulliparous cows. That's just not enough cows to definitively say yes or no if a change in diet caused a change in outcome.

New research from the University of Florida, and recently published in the *Journal of Dairy Science*, sheds new light on some of the questions surrounding acidogenic diets and nulliparous cows. The study was conducted at the University of Florida dairy unit in Gainesville. At about 250 days of gestation, 132 nulliparous cows were randomly assigned to 1 of 3 different DCAD diets: +200, -50 and -150 mEq/kg of DM until calving. All prepartum diets had the same forage-to-concentrate ratio and similar contents of NE_L, crude protein and metabolizable protein. After calving all cows were fed the same lactation diet, milked 4 times daily during the first 100 days in milk and then 2 times daily through 305 days in milk to determine cumulative milk. All cows received timed A.I. for their first insemination.

The range of DCAD used in the study is similar to the range of DCAD reported in the two meta-analyses. In addition, current research recommends that multiparous cows be fed a prepartum diet with a DCAD between -50 to -150 mEq/kg to reduce the risk of hypocalcemia.

MILK PRODUCTION

As expected, DMI declined linearly with the decrease in DCAD during the prepartum period. Because of the reduced DMI, the intake and balance of NE_L also decreased linearly during the prepartum period. But during the first 100 days in milk there were no differences in DM or NE_L intakes between dietary treatments.

Dietary treatment did not affect colostrum yield. Nor did it affect the concentrations or yields of fat, true protein, lactose, solids not fat in colostrum, Brix value or the total IgG concentration of the colostrum.

Milk yield also was not affected by dietary treatment. Nulliparous cows fed prepartum diets with +200, -50 and -150 mEq/kg produced an average of 80.7 lbs, 80.9 lbs and 79 lbs of milk, respectively, during the first 100 days in milk. Energy corrected milk and 3.5% fat corrected milk were also not affected by dietary treatment. Cows fed a moderate negative DCAD diet of -50 mEq/kg had the highest 305-day cumulative milk yield producing 22,057 lbs, but it was not statistically different from cows fed the other two dietary treatments.

"Our results clearly demonstrate that manipulating the DCAD of prepartum diets fed to nulliparous cows did not affect composition or yield of colostrum, productive performance in the first 14 weeks of lactation or the cumulative milk yield at 305 days postpartum," explains Santos. "We feel confident in telling producers that there is no advantage of feeding acidogenic diets to nulliparous cows if the objective is to improve productive performance."

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NEW RESEARCH ON NULLIPAROUS COWS AND NEGATIVE DCAD DIETS

REPRODUCTION

The study also looked at reproductive performance. Results showed there was no difference from dietary treatment in the pregnancy at the first AI. However, at the end of the 305-day observation period, there was a significant difference in the percent of cows pregnant by dietary treatment. Nulliparous cows fed the most acidogenic diet had the greatest percent of pregnant cows: 93.2% compared to 88.9%, and 76.7% for cows fed the -50 and +200 mEq/kg diets, respectively. While this experiment provides initial evidence that acidogenic diets may influence reproduction in nulliparous cows, more research is needed to replicate results.

HEALTH

The urine pH of nulliparous cows averaged 8.22, 6.67 and 5.41 for cows fed prepartum diets with a DCAD of +200, -50 and -150 mEq/kg. No cases of clinical milk fever were diagnosed. Results of both iCa and tCa showed that none of the cows' calcium concentrations dropped below established thresholds for subclinical hypocalcemia.

Incidence of clinical diseases, which included retained placenta, metritis, displaced abomasum, mastitis, lameness and respiratory diseases, were tracked from calving through the first 100 days in milk. "We were able to detect quadratic differences in uterine disease, morbidity and the risk of multiple diseases," says Santos. Cows fed the -50 mEq/kg diet had less risk of those issues than the mean of cows fed the +200 and -150 mEq/kg diets. Results for disease incidence for cows fed -50, + 200 and -150 mEq/kg diets were as follows: uterine disease, 25.6, 36.3 and 46%; for morbidity, 28.1, 41.4 and 55.6%; and for multiple disease it was 8.9, 16.3 and 29.6%, respectively.

Although reductions in the risk of disease shown from feeding the -50 mEq/kg diet were large, the total number of cows in each treatment was limited to make inferences related to health and reproduction. As with any first of its kind experiment, the study will need to be replicated to improve the strength of the data and to be able to provide concrete recommendations for dairy producers.

At this point "we can say that feeding acidogenic diets to prepartum nulliparous cows up to -150 mEq/kg has no effect on milk production," says Santos. "We can also say that overfeeding anions (causing excessive metabolic acidosis with a urine pH <5.8) is a bad idea for nulliparous cows." Inducing excessive metabolic acidosis impairs energy metabolism in part because of the reduced intake but, more important, because of the negative effect uncompensated metabolic acidosis has on regulatory hormones that are important for energy metabolism.

So, if your multiparous cows and nulliparous cows share the same prepartum pen and diet, you might want to consider feeding a DCAD diet closer to -50 than to -150 mEq/kg or provide separate pens and diets.

Zimpel et al., 2021. J. Dairy Sci. 104:11699-11714.
Zimpel et al., 2021. J. Dairy Sci. 104:12580-12599.

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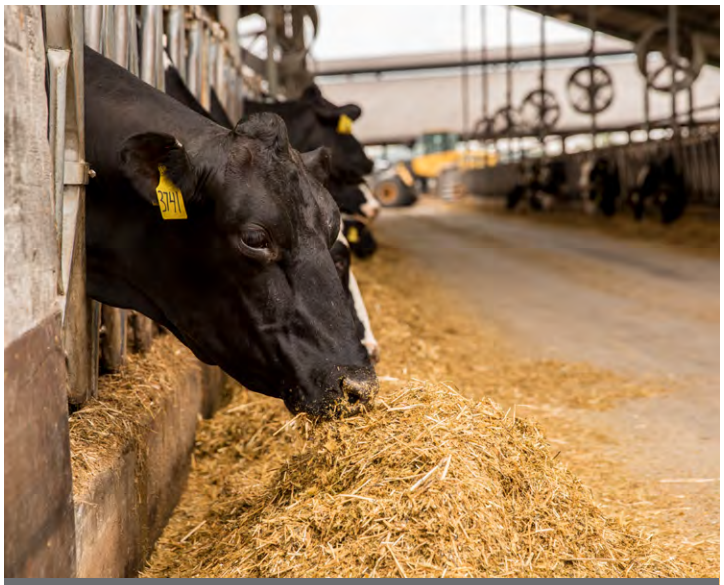

FROM THE MATERNITY PEN

Changes in Cow Activity Prior to Calving May Predict Disease

New research in the *Journal of Dairy Science* examined if accelerometers could be used to predict postpartum disease. In the trial 489 multiparous cows on a commercial Holstein dairy in Spain were fitted with accelerometers and monitored from 3 weeks prior to 30 days after calving. The accelerometers combined with a sensor to detect cows at the feed bunk were used to measure steps, time spent at the feed bunk, frequency of meals, number of lying bouts and total time spent lying.

During the first 30 days in milk 144 cows, 29.4%, were diagnosed with at least one disease. The remaining 345 cows had no disease diagnosed (NDD). When prepartum activity was analyzed as a 3-week block no differences were found. Cows averaged 1,613 steps, spent 181 minutes at the feed bunk, ate 8.3 meals and spent 742 minutes lying during 9.8 lying bouts.

But when researchers examined activity in just the week before calving and evaluated results for individual diseases, differences that were statistically significant and predictive emerged. Cows diagnosed with metritis spent 32 more minutes at the feed bunk than cows NDD, 188 vs. 156 minutes/day. Cows diagnosed with a displaced abomasum (DA) ate 24% fewer meals, 6.2 vs. 8.2 meals/day, for cows NDD. There was also a tendency for DA cows to take fewer steps, 1,395 vs. 1,708 for cows NDD. And for cows diagnosed with ketosis 2 predictors were identified: time at the feed bunk and number of meals per day. Ketotic cows spent 62 fewer minutes/day eating and ate fewer meals 6.4 vs. 8.2 meals/day when compared to cows that were not diagnosed with ketosis.

Researchers were able to develop prediction models to classify animals as high and low risk for DA and ketosis. But due to the small number of clinical cases the false discovery rate was higher than anticipated. Refinement will help improve accuracy before prediction models are used on farm.

Belaid et al., 2021. J. Dairy Sci. 104:4575-4583.

CONSULTANTS CORNER

Economics of Dietary Protein Change Include Milk, Body Weight

By ***MIKE VANDEHAAR*** Michigan State University

Dietary protein is expensive. And as an industry we have generally overfeed protein just a bit so that cows can produce milk to their full genetic potential. Recent research has examined if we can reduce dietary protein without sacrificing milk. But what about all the other ways cows use protein? What about lost body weight from increased tissue mobilization or lost growth in first-calf heifers when the diet lacks needed protein? Can the cow mobilize protein from body stores to overcome a protein deficit long term? And if so at what cost?

At Michigan State University we designed a study to answer those questions. A total of 166 cows were enrolled in the study, 92 primiparous and 74 multiparous. We compared high and low protein diets during peak lactation (50 to 130 days in milk) and during late lactation (190 to 250 DIM). A crossover design was used so that all cows received each treatment. Diets were as follows:

- Peak Milk Low Protein: 14% CP, 31% NDF, 32% starch, 9.8% RDP.
- Peak Milk High Protein: 18% CP, 29% NDF, 30% starch, 9.8% RDP.
- Late Lactation Low Protein: 13% CP, 40% NDF, 26% starch, at least 9% RDP.
- Late Lactation High Protein: 16% CP, 38% NDF, 24% starch, at least 9% RDP.

The high protein diets contained more metabolizable protein than required by the average cow in the study based on NRC (2001). Low protein diets were designed to be deficient and supplied 83 and 95% of the required metabolizable protein in peak and late lactation, respectively. Body weight for all cows was recorded 3 times a week immediately after the evening milking.

During both peak and late lactation cows fed the low protein diets ate less, produced less milk, and gained less body weight and less empty body weight than cows fed the high protein diets. In addition, the low protein diet decreased the digestibilities of DM, NDF and CP by 2.8, 2.8 and 6.2 percentage units respectively during peak milk compared to the high protein diet. The decrease in digestibilities of DM, NDF and CP continued in late lactation with changes of 2.0, 1.8 and 7.2 percentage units.

We also assessed energy losses from feeding the low protein diet. Body weight change from feeding the low protein diet during peak lactation accounted for 43% of the decrease in captured energy and 11% of the decrease in captured protein. In late lactation, body weight change from feeding the low protein diet accounted for 51% of the decrease in captured energy and 14% of the decrease in captured protein. Feeding less protein combined with the reduced DMI did reduce feed cost, but the cost of lost milk and lost body weight was far greater. The loss in net profit, based on current prices, was 27% greater during peak lactation, and 45% greater in late lactation, when losses in body weight and milk were both considered instead of milk only losses.

Feeding less dietary protein impacts more than just milk production. Our data clearly shows that body weight changes can be detected in studies of only 4 weeks. We recommend that body weight change should be routinely measured in studies that evaluate cow response to dietary change in protein content, protein source or amino acid supplements in order to fully comprehend the total cost effectiveness of the dietary change. In addition, we suggest that nutrition consultants also consider ways to assess the full response of cows to dietary protein changes. To learn more about our research please see the November *Journal of Dairy Science*.

E. Liu et al., 2021. J. Dairy Sci. 104:11567-11579.

BEYOND BYPASS

Corn Silage Hybrid Increased Milk, Feed Efficiency

The Enogen brand corn hybrid may have been developed for the ethanol industry to improve efficiency of ethanol production, but new research from Penn State University shows that it may make great corn silage for dairy cows, too. The Enogen hybrid is amylase enabled which means the amylase enzyme is deposited into the endosperm of the grain. (Amylase is used to help digest carbohydrates and starch.) And new research shows that when lactating dairy cows are fed corn silage made from the Enogen hybrid that milk production and feed efficiency increase and the intensity of methane (CH_4) emission decreases.

Researchers grew Enogen and its isogenic counterpart (genetically similar but not amylase enabled) and harvested each for silage. Corn silage yield was 7.1 tons/acre for Enogen and 7.6 tons/acre for the isogenic or control. Silage dry matter was similar. The Enogen corn silage had 6% lower CP, 3.9% lower ADF concentration, 7% lower lignin, 14% lower 240-h NDF digestibility, but 2.6% higher 30-h NDF digestibility and 8.5 and 10% higher starch content (two labs independently analyzed samples for starch) than the control silage.

Next, 48 Holstein cows, 78 days in milk producing 97.6 lbs/day of milk, were randomly assigned to receive a diet formulated with 40% Enogen corn silage or 40% control corn silage. Cows were fed a TMR once daily with regular feed push up and milked twice daily. Dry matter intake was the same for both groups. However, cows fed the Enogen corn silage produced 4.4 lbs more milk per day, and feed efficiency improved from 1.47 to 1.55 lbs of milk per lb of dry matter intake. Energy-corrected milk yield was not different between the Enogen and control diets.

Researchers also measured cows' gas emissions. While daily enteric methane emissions did not differ, emissions per lb of milk produced decreased. Researchers concluded that the effects seen were likely the result of greater corn starch intake and overall availability of digestible nutrients.

Cueva et al., 2021. J. Dairy Sci. 104:9827-9841.

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