ADSA 2024

Adisseo Sponsored Abstracts Highlights

Exploring the Benefits of Amino Acid Nutrition for Lifetime Performance

Research exploring the benefits of amino acid nutrition for ruminants continues to receive significant interest. Numerous new abstracts related to amino acid and protein nutrition were presented during the American Dairy Science Association (ADSA) annual meeting in 2024. Among these, nine were sponsored by Adisseo, focusing on key areas where amino acid balancing impacts dairy cow performance and health.

KEY HIGHLIGHTS

- *The fruits of our 40+ years of research are now the capability to accurately predict the response in milk, milk fat, and milk protein yields to reformulating diets for higher levels of metabolizable methionine and other amino acids, as demonstrated by the meta-analysis presented.*
- *Multiple studies confirmed the importance of amino acid stimulation of mechanistic target or rapamycin (mTOR) to promote milk fat synthesis, highlighting the role of amino acids beyond milk protein.*
- *Data confirmed that methionine supplementation to transition cows during heat stress improves cows' performance and improves nutrient flow to the fetus that can impact calf development.*

Check out the summary of Adisseo sponsored abstracts at ADSA 2024 ▶

WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON

2028

Histidine, lysine, and methionine effects on milk components production and nitrogen efficiency

Balancing dairy cow rations for amino acids has been observed to enhance milk production and improve nitrogen efficiency. Methionine and lysine, considered the first limiting amino acids in dairy cow diets, have been extensively studied and are known activators of mechanistic target of rapamycin (mTOR). Activation of mTOR is essential for milk production and promotes milk protein and fat synthesis. While histidine is considered the third limiting amino acid, responses to histidine supplementation have been inconsistent, and histidine has no effect on mTOR activity.

It was hypothesized that mTOR stimulation is needed for histidine to influence milk protein production. The trial evaluated the effects of balancing diets for histidine, in addition to methionine and lysine, on milk production and nitrogen efficiency. Despite there being no interaction between histidine and methionine and lysine, both factors independently increased energy-corrected milk by increasing milk fat and protein yields without negatively affecting nitrogen efficiency. This underscores the importance of a coordinated amino acid supply to optimize mTOR activation for mammary gland output.

VIRGINIA TECH

2186

Milk fat synthesis from dairy cows receiving a jugular infusion of isoleucine or leucine

Leucine and isoleucine, known activators of mechanistic target of rapamycin (mTOR), play a role in promoting milk protein synthesis. Recent research suggests that these amino acids may also stimulate milk fat synthesis via mTOR activation.

This trial evaluated the effects of jugular infusions of isoleucine and leucine on milk fat synthesis. Increasing the individual circulating concentrations of isoleucine or leucine resulted in increased milk fat synthesis. However, there was no additional effect when both amino acids' circulating concentrations were increased simultaneously. These findings enhance our understanding of how amino acids influence milk component production and underscore the importance of formulating dairy cow diets to include specific amino acids.

University of New Hampshire

2188

A meta-analysis to identify factors impacting milk component responses to metabolizable methionine fortification with Smartamine® M or MetaSmart® evaluated based on CNCPS

Using rumen-protected methionine (RPM) is a common method for increasing the supply of metabolizable methionine in dairy cow rations. When RPM is added to diets, increases in both milk protein and fat synthesis have been observed. Previous meta-analyses included data from trials using different commercial products. The researchers used the published bioavailability of these products; however, the true bioavailability of those products may not be as described in the software models used to design the rations. Equations predicting the responses to RPM are limited. Therefore, the objective of this study was to better understand milk fat and protein responses to RPM (Smartamine M and MetaSmart), whose bioavailability was tested using the dose-response methodology, and the factors that impact those responses based on CNCPS. The models uncovered via the meta-analysis successfully predicted responses of lactating dairy cows to RPM supplementation and determined factors that affect milk protein and fat production responses to RPM. Furthermore, these models and factors can help nutritionists more accurately formulate the amino acids in dairy cow diets.

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2189

Rumen protected amino acids for fresh cows

It is well documented that balancing diets for methionine and lysine during the transition period improves performance. However, research is lacking on the effects of supplemental methionine and lysine during the fresh period alone. This trial investigated the effects of supplying rumen-protected methionine and lysine from calving until 63 days in milk. Supplying both rumen-protected methionine and lysine in early lactation improved milk fat and protein yields, as well as energy and fat-corrected milk, reinforcing the importance of methionine and lysine to maximize milk production responses in the fresh period.

2469

A meta-analysis to identify factors affecting milk component responses and intake of dairy cows to metabolizable methionine fortification evaluated based on INRA 2007

Over the last few decades, the use of rumen-protected methionine (RPM) to enhance metabolizable methionine in dairy cow diets has been increasing. When RPM is added to the diet of lactating dairy cows, it is common to see an increase in dry matter intake, milk yield, and milk component production. However, equations that predict production responses to RPM and factors that impact these responses are limited. Additionally, previous meta-analyses included data from trials using different commercial products, relying on published bioavailability figures that may not accurately reflect true bioavailability.

The objective of this study was to utilize data based on INRA 2007 to identify equations that predict milk yield, milk fat yield and percentage, and dry matter intake in response to RPM supplementation, whose bioavailability was tested using the dose-response methodology, and to determine the factors that may influence these responses. The meta-analysis successfully predicted production responses of dairy cows to RPM supplementation and identified factors affecting these responses, providing valuable insights that can help us better formulate diets for metabolizable methionine using the INRA 2007 model.

1410

Metabolic and transcriptomic responses to dietary-induced milk fat depression and balanced amino acid supplementation in lactating dairy cows

Supplying methionine and leucine in dairy cow diets has been observed to increase milk fat synthesis via activation of mechanistic target of rapamycin (mTOR). Previously, the authors reported that supplemental methionine and leucine were not able to overcome milk fat depression induced by soybean oil but did independently increase milk fat yield, partially overcoming the negative effect of overfeeding soybean oil. This abstract was designed to evaluate if supplying methionine and leucine could help promote metabolic and transcriptomic responses that support milk fat synthesis during milk fat depression induced via dietary polyunsaturated fatty acids. Supplying soybean oil and amino acids both altered metabolic transcriptomics of adipose and mammary tissue. The metabolic pathways altered by amino acids in the mammary gland likely support the increased milk component production reported previously.

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2582

Effects of varying isoleucine, leucine, lysine, and methionine concentrations on milk fat synthesis in mammary epithelial cells

Balancing dairy cow diets for amino acids is well documented to increase milk protein, which is linked to activation of mechanistic target of rapamycin (mTOR). Recent research has also revealed that stimulation of mTOR signaling pathways by amino acids can also increase milk fat production. However, information on the interplay between essential amino acids that activate mTOR is still limited.

This trial aimed to evaluate the effects of isoleucine, leucine, lysine, and methionine on milk fat synthesis in mammary epithelial cells. Supplying combinations of these essential amino acids altered de novo milk fat synthesis, with methionine and isoleucine having the greatest effect. These results further point to the importance of balancing dairy cow diets for amino acids to support not only milk protein, but also milk fat.

2757

A meta-analysis to identify factors affecting milk component responses to metabolizable methionine fortification with Smartamine® M or MetaSmart® evaluated based on NRC 2001

The use of rumen-protected methionine (RPM) products in dairy cow diets to increase metabolizable methionine supply has been observed to enhance both milk fat and protein synthesis. The NRC 2001 software is commonly used to balance dairy cow diets; however, equations predicting milk protein and fat responses to RPM and the factors impacting those responses are limited.

The objective of this study was to better understand responses to RPM supplementation (Smartamine M and in diets based on NRC 2001, using commercial products and the dose-response methodology to determine their bioavailability. A meta-analysis was conducted to predict the responses of lactating dairy cows to the percentage of metabolizable methionine in the diet, along with other dietary factors that could influence those responses.

The results of this study provide valuable insights into how RPM supplementation influences milk protein and fat production, enhancing diet formulation for lactating dairy cows within the NRC 2001 model.

1608

Supplementation of rumen protected methionine to late gestation heat-stressed cows: impact on calf amino acid metabolism and liver gene expression

In-utero heat stress exposure has been documented to have lifelong impacts on dairy cattle. Methionine has been observed to provide health and production benefits for both the dam and offspring when supplemented during the peripartum period. Recent research has also indicated a benefit of methionine on dairy cow milk composition and metabolism during periods of heat stress. However, the effects of methionine supplementation during transition period heat stress on offspring growth and metabolism have not been investigated.

This study aimed to evaluate the growth and metabolism of Holstein heifers born to cows that were fed rumen-protected methionine and exposed to heat stress in late gestation. Heat stress negatively affected placenta size and amino acid metabolism, as well as liver metabolism of calves at birth. However, methionine rescued placenta weight and transfer of nutrients, particularly amino acids. It was previously reported that calves in this study were taller at birth when their dams were fed methionine during transition period heat stress.

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1608 continued

Thus, the observed changes in placenta function likely support the nutrition that the calf needs to grow to be taller at birth. Overall, these results highlight the essentiality of balancing diets transition diets for methionine to help calves overcome the negative effects of in-utero heat stress on growth and metabolism.

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ADSA Research Summaries_US_06/24

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