"Does providing additional protein in late gestation reduce protein catabolism and improve cow and calf performance?"

DOES PROTEIN SUPPLEMENTATION FOR PREGNANT COWS IMPROVE PRODUCTION?

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Background: As a calf grows, the nutrient requirements of the cow increase substantially. In cases where energy demand exceeds the nutrients available, skeletal muscle may be used as a source of energy.

Previous research showed an increased level of protein turnover markers in nutrient restricted cattle during mid to late gestation. Although not measured, this could have had negative impact on the reproductive performance of the cow during lactation and rebreeding, when a significant amount of energy would be required to rebuild any muscle tissue broken down in late gestation.

Generally, energy supplementation has been most often used to offset any nutrient balance deficiencies in late gestation. Very little research exists as to the effects of protein supplementation, which would provide amino acids as a source of energy for the cow and fetus, and would not lower rumen pH to the same degree as grain supplementation. In addition, we know that the maternal diet can have long lasting impacts on calf development, even after birth, and an increased protein supply may benefit the calf's future growth and performance.

Objectives: The objectives of this study are to:

1. Investigate the effect of protein supplementation during late gestation on pre- and post partum cow performance, protein metabolism, and nitrogen balance.
2. Evaluate the impact of late gestation maternal protein supplementation on passive immune transfer and growth performance of the calf.

What they did: 24 crossbred bred heifers were fed either 133% of the metabolizable protein requirement, or 100% of the requirement during the final two months of gestation, with some of the heifers in each group fitted with rumen cannulas. All other components of the diet remained the same, and post-calving all cows were fed the same diet. Dry matter intake, body weight, rib and rump fat thickness, nitrogen balance, blood metabolites, digestibility, rumen fermentation, muscle metabolism, colostrum composition and yield, and calf growth performance were measured both prior to calving and post-calving. Two cow-calf pairs had to be removed from the study after calving, one due to dystocia and one due to aggression.

Prior to calving, cows were housed and fed individually. After calving they were individually fed a diet formulated to meet the requirements of lactation for the first 33 d, and then housed in small groups until approximately four months after calving, the conclusion of the trial.

What they learned: Pre-calving: Neither body weight nor rib and rump fat differed between the adequate and high protein groups, although there was a numerical increase in the high protein group. Dry matter intake increased in both groups, as might be expected, until about a week before calving, and then decreased. Total tract digestibility was greater for the heifers on the high protein diet. Rumen pH and proportions of short-chain fatty acids did not differ between treatment groups. Similarly, blood metabolites like plasma glucose, non esterified fatty acids, and beta-hydroxybutyrate were not different between treatments, suggesting that overfeeding metabolizable protein did not affect energy balance. The high protein group produced 2.6 kg/day more urine, and 70 and 96% more fecal and urinary nitrogen. Overall nitrogen digestion was greater in the high protein group, increasing from 106% 34 days prior to calving to 134% 15 days prior to calving. Cattle fed high protein also had improved nitrogen retention. Urinary markers of skeletal muscle catabolism did not differ between treatments, but muscle concentrations of calpain tended to be greater and calpastatin abundance was almost 52% greater in the normal protein group.

Post-calving: Again, body weight and rib and rump fat did not vary between treatments; however, there was a similar decrease in rump fat as cows in both groups progressed through lactation. Dry matter intake also remained similar between groups. Colostrum composition was similar for cows fed both protein levels, but the high protein cows had decreased colostrum fat concentration, resulting in a tendency for the net energy concentration of colostrum to be higher for the cows fed 100% of metabolizable protein requirements pre-calving. Serum IgG (a marker of maternal immunity transfer) in calves did not differ between treatments. As days in milk advanced, milk protein and lactose yields gradually declined for both groups. Contrary to the pre-calving results, there was no difference in calpastatin concentration post-calving. Calf average daily gain did not differ, either. There were some differences in gene expression in the calves, most notably, insulin-like growth factor I (IGF-I) expression was increased in the calves from dams fed the high metabolizable protein diet, while insulin-like growth factor II reception (IGF-IIR), myogenic factor 5 (MYF5), and 2-hydroxyacl-CoA lyase 2 (HACL2) expression was decreased.

What it means: This study was designed to determine the effects of oversupplying metabolizable protein during late gestation on nutrient intake, ruminal fermentation, nitrogen balance and whether carry over effects would persist post-calving.

Neither group appeared to be in a negative nitrogen balance (i.e. using muscle mass to meet protein requirements) during the course of the study. However, supplying extra protein in late gestation did improve nitrogen retention, total tract digestibility, and rumen fermentation. There were minimal carry over effects to the post-calving period, but substantial variation in dry matter intake and rumen fermentation during early lactation likely impacted nutrient balance during those periods.

Protein supplementation is expensive, and given the results of this study, would likely have a low return on investment as long as the animal's requirements are met. However, this study did raise some questions for future work, such as: Should cow-calf ration formulation shift to metabolizable protein as the requirement rather than crude protein? What is the level of rumen degradable protein that maintains the most efficient rumen function and fibre digestion rate? Is the observed decrease in rumen pH prior to calving in both groups typical of cows in a non-research scenario, and does that decrease increase susceptibility to sub-acute rumen acidosis? Are there other pre- or post-calving nutritional strategies to optimize milk production or composition in order to improve calf performance?

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