Protein Nutrition for the Transition Cow

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Focusing on the Wrong Time Period?

Historically, research has focused almost exclusively on the effects of protein content of the prepartum diet (Bell et al., 2000; Robinson et al., 2001). However, there has been little research conducted on the postpartum protein needs of transition cows. So, what do the research results on prepartum protein feeding tell us and have we focused too much time and effort on the wrong time period? The research results demonstrate that increasing prepartum protein content has little benefit except in cases where prepartum CP is below 12% or postpartum CP is below 16% (Bell et al., 2000). In a large commercial herd study conducted by Robinson et al. (2001), prepartum diets were balanced to contain either 11.7% CP or 14.4% CP with the increase in CP coming from feeds containing high RUP. In this study, increasing prepartum CP content had no effects on postpartum performance of multiparous cows, but increased milk yield and decreased milk fat yield in primiparous cows. These results, or perhaps lack of results, may indicate that we have indeed focused on the wrong time period as the range of recommended CP levels for cows and heifers is relatively large (~12-16%; Figure 1) and does not appear to be a critical factor in postpartum performance as was once believed. So, if prepartum protein nutrition does not appear to be a critical factor in postpartum performance, what do we know about the effects of postpartum protein nutrition on postpartum performance?

Postpartum Protein for the Transition Cow

Interestingly, there is very little information on the effects of amino acid (AA) balancing prepartum on postpartum performance. Nearly all studies have initiated AA balancing prepartum and continued treatments postpartum, thus making it impossible to determine the carry over benefits of prepartum AA balancing. Similarly, there is a paucity of data regarding the importance of protein and AA content of early postpartum diets as nearly all studies have either initiated treatments prepartum and/or postpartum and continued beyond the first three weeks of lactation. This makes it difficult to assess protein requirements of the early postpartum cow. Research from Bell et al. (1995) indicates that in the first two weeks postpartum, the apparent endogenous requirement of AA for gluconeogenesis is approximately 500 g/d and the cow will lose nearly 25% of her skeletal protein mass. It is important to note that this requirement for endogenous AA is only to support gluconeogenesis and does not account for AA required for milk protein synthesis or protein accretion.

An important question is what effect does reducing total dietary CP, particularly during the early postpartum period, have on production, health and reproduction? Cost of protein and environmental concerns are pressuring dairy producers to reduce dietary CP. Many dairy management systems utilize a one-group or two-group pen system, which means there is no post-fresh group at all or there is a pen where fresh cows reside for only a few days to monitor for temperatures and clinical signs of metabolic problems. As a result, fresh cows consume the same diet as later lactation cows, which means as diet CP levels are reduced fresh cows are also consuming less CP. Is a diet containing 15% CP too low for the immediate post-fresh cow which is in a negative protein balance and is mobilizing significant amounts of skeletal protein?

Recently, researchers in Denmark (Larsen and Kristensen, 2012) conducted a study to determine the effects of alleviating the postpartum protein deficiency on lactation. The researchers abomasally infused either water (Control) or 360 g of casein on day 1 postpartum, 720 g on d 2, and then gradually reduced the infused level of casein by 19.5 g/d from d 3 to d 29 postpartum ending with 194 g/d (CAS). The results of this study were astounding as the CAS cows responded by producing 96.5 lb of milk compared to 80.6 lb of milk for the Control cows; $P < 0.01$ (Figure 2). Milk protein production was also increased at 4 DIM in CAS (1664 g/d or 3.8%) compared to Control (1212 g/d or 3.3%) but did not differ at 29 DIM (1383 g/d; interaction: $P = 0.02$). Perhaps the most interesting result of the study was that despite the significant increase in milk production, DMI did not increase with CAS infusion; however, blood nonesterified fatty acids (NEFA) was increased with CAS infusion. The authors concluded that milk and milk protein production is driven by supply of AA at the initiation of lactation. As a result, supplying postpartum transition cows with additional high quality protein will increase the efficiency of milk and milk protein production.

The results of this study generates two further questions: 1) if post-fresh transition cows supplied with additional high quality protein increase milk and milk protein production, will providing nutrients such as methionine or choline, which can spare Met, also result in significant increases in milk and milk protein production without needing to supplement as much protein to the diet? and 2) What are the effects of elevated blood NEFA if cows provided with high quality protein do not increase dry matter intake to support the additional milk production? As a result, more NEFA were supplied to the liver and ideally they would have been repackaged into VLDL molecules and transported to the mammary gland to supply energy. Since choline deficiency often limits this process (Goselink et al., 2013), would feeding rumen-protected choline, in conjunction with supplying higher quality protein, result in even a larger response in milk and milk protein production?

Conclusion

The pressure to feed lower CP diets will continue. Some of the effects of reducing CP can be mitigated by supplementing protected AA that are most limiting, particularly in cows that are beyond the period of low feed intake and intense negative nutrient balances. Post-fresh transition cows that have very low feed intake are likely to need diets that contain higher nutrient densities than cows in later lactation. This certainly appears to be the case for protein as demonstrated by the Danish research. Separate pens and specially formulated diets are needed for post-fresh transition cows. It is recommended that nutritionists balance diets prepartum and postpartum for AA by feeding high quality RUP and protected AA sources and consider feeding rumen-protected choline to maximize methionine utilization for protein synthesis and transfer of fatty acids from body reserves to the mammary gland for use in milk synthesis.

Figure 1. Recommended crude protein content of prepartum diets with and without mammary gland growth requirement. Adapted from NRC (2001).

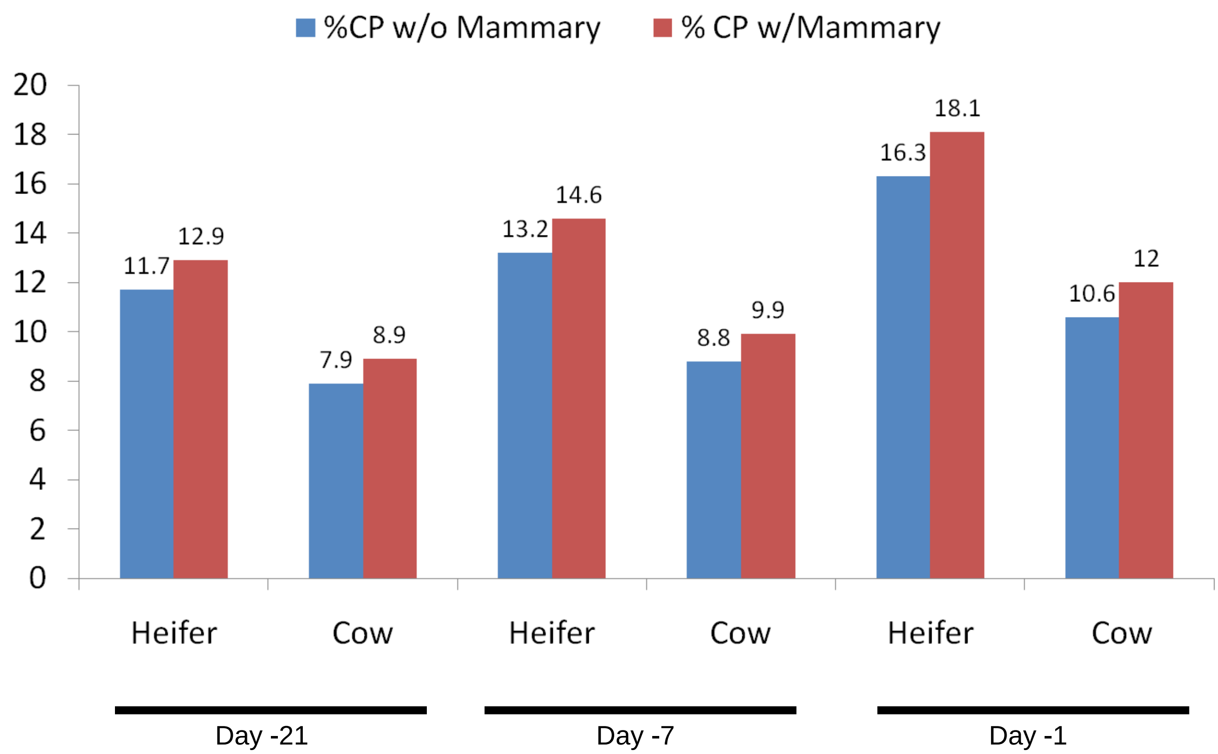
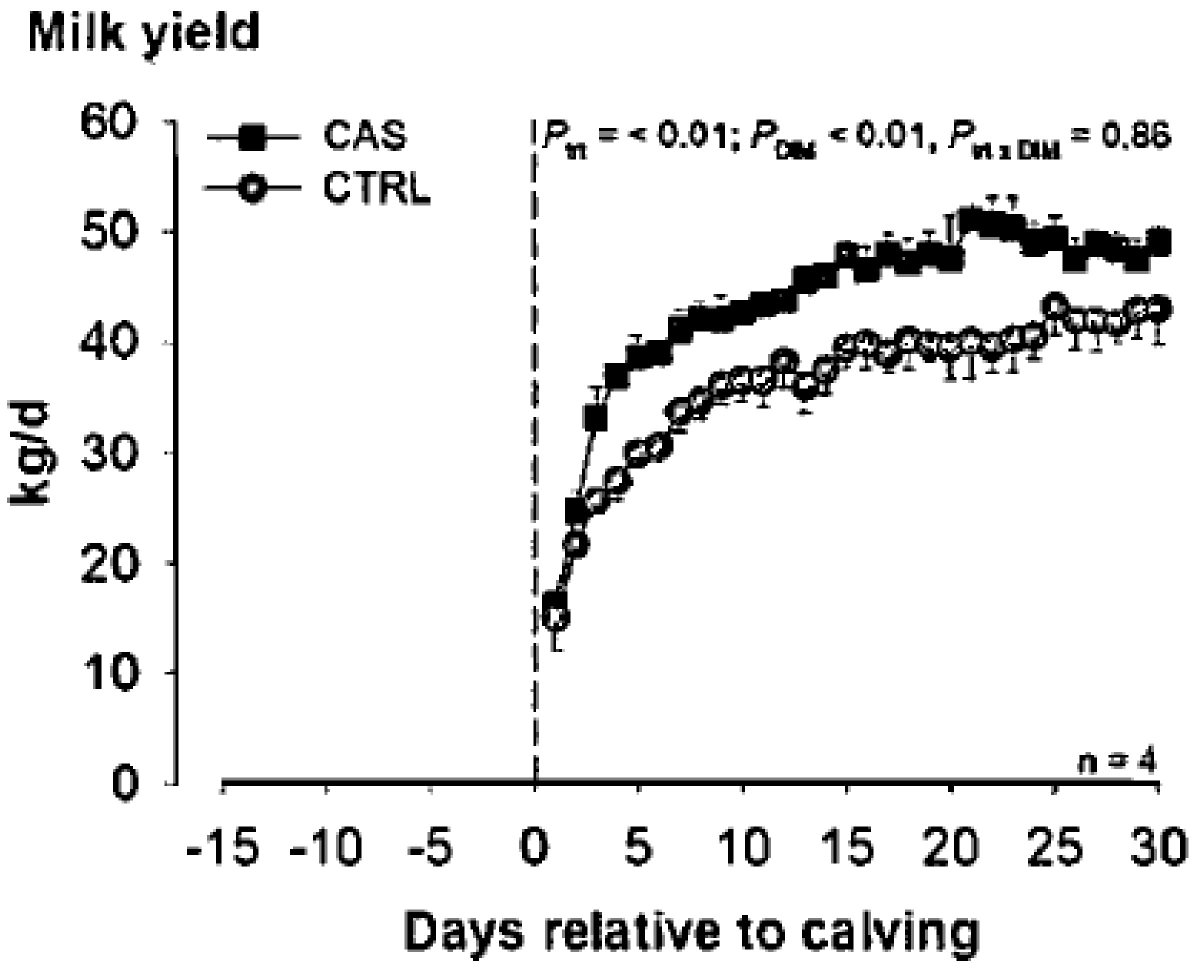


Figure 2. Milk production results from Larsen and Kristensen (2012) study where postpartum cows were abomasally infused with water (Control) or casein (CAS).



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