Transition management of dairy cattle: New insights

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There was a major review of management of the periparturient (transition cow) for the dairy industry by Lean and DeGaris in (2010). Since then there have been substantial developments in understandings of transition management, many of which have focussed on aspects of calcium (Ca) metabolism. Notable developments in this period are an understanding that feeding a diet that provides a negative dietary cation anion difference (NDCAD) can increase milk production and improve reproduction and health. Questions remain in regard to the mechanisms by which these changes in pre-calving metabolism result in prolonged lactational responses.

Goff et al. (2014) demonstrated in an elegant study that cows on a NDCAD diet had much higher Ca and $1,25(OH)_2D_3$ concentrations than cows similarly challenged with PTH injections fed on a positive DCAD diet. Martinez et al. (2014) used an induced hypocalcaemia protocol to demonstrate that hypocalcaemic cows were insulin resistant and that these had increased dependence on fatty acid mobilisation and ketone production during the period of hypocalcaemia.

The recent meta-analyses of the effects of NDCAD diets found that milk production is increased after calving for multi-, but not, primi-parous cows (Lean et al., 2019; Santos et al., 2019). However, dry matter intake after calving is increased, as is blood Ca by NDCAD. Importantly, odds of clinical hypocalcaemia, retained placenta, metritis, and overall disease were all substantially lowered by NDCAD diets (Lean et al., 2019; Santos et al., 2019). Investigations of the effects of vitamin D metabolites, particularly 25-hydroxycholecalciferol (25-OHD) have identified that supplementation improved killing activity of neutrophils postpartum and reduced incidence of retained placenta and metritis (Martinez et al., 2018a, b). Combining a NDCAD with 25-OHD_3 reduced morbidity in early postpartum, and 25-OHD_3 tended to increase the rate of pregnancy (Martinez et al., 2018a). There are also reports of effects of 25-OHD_3 in reducing severity of mastitis.

Interactions among hormones point to a critical role of bone hormones in energy metabolism (Rodney et al., 2018). Strong associations were found between vitamin D and IGF-1 and more strongly between osteocalcin and IGF-1, showing clear evidence of feedback mechanisms, and osteocalcin with glucose. Further, Ca concentrations are associated with blood-free fatty acids (NEFA), blood 3-hydroxybutyrate, glucose, and cholesterol (Lean et al., 2014), again highlighting potential roles for bone in metabolism and Ca as a second messenger. There is now also evidence of cross-talk between mammary and amino acid metabolism and bone mediated through 5-hydroxytryptamine, serotonin, and parathyroid releasing hormone. These understandings are being incorporated into dietary strategies that are reducing the risk of clinical and sub-clinical hypocalcaemia.

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