FUNCTION AND GENE EXPRESSION OF CIRCULATING NEUTROPHILS IN DAIRY COWS: IMPACT OF MICRONUTRIENT SUPPLEMENTATION

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ABSTRACT

Three experiments were conducted to investigate the mechanisms of neutrophil dysfunction during the periparturient period and test potential nutritional strategies to prevent the immune-alteration typical of this time. The in vitro effects of *Escherichia coli* lipopolysaccharide (LPS) on the function of bovine neutrophils (PMNL) and expression of selected genes were examined. Lipopolysaccharide directly stimulated PMNL from midlactation cows (n = 7) to produce reactive oxygen species (ROS), and release of neutrophil extracellular traps (NETs) Furthermore, LPS stimulated the gene expression of tumor necrosis factor-α (TNF), bactericidal/permeability increasing protein (BPI) and cytochrome *b* (CYBA) in PMNL from midlactation (n = 10), but not from early lactation (n = 10) cows. In the second experiment, the effects of a B-vitamin dietary and yeast supplement on the function and global gene expression of PMNL from periparturient dairy cows were tested. Cows received 56 g/day of either OmniGen-AF® (n = 8) or sham control (n = 12) from day 46 before calving until day 31 after parturition. Although no differences in PMNL function were detected between supplemented and non-supplemented cows, Omnigen-AF® down-regulated the expression of genes that enriched the lysosome pathway (upon activation with LPS) and decreased the expression of transcripts in the oxidative phosphorylation pathway (regardless of LPS activation). The objective of the third study was to investigate the effects of trace mineral supplementation from inorganic or organic sources on PMNL function and global gene expression in dairy cows. Thirty nine pregnant

Holstein cows were assigned to a basal diet with no added dietary Mn, Co, Cu or Zn (basal, n = 13) or supplemented with 200 mg Mn, 25 mg Co, 125 mg Cu, and 360 mg Zn from inorganic (n = 11) or organic (n = 11) sources. Cows supplemented with trace minerals from inorganic sources had a 39% increase in the amount of *E. coli* particles phagocytized by PMNL on day 6 postpartum, compared with cows receiving no supplemental trace minerals. Trace mineral supplementation from either inorganic or organic sources resulted in minimal changes in gene expression in non-activated and LPS-activated PMNL, relative to cows fed the basal diet. However, organic trace mineral supplementation (vs. inorganic) up-regulated the expression of genes that enriched the RIG-I-like receptor signaling, cytosolic DNA-sensing, and TOLL-like receptor (TLR) signaling pathways. In conclusion, we identified several cellular and molecular mechanisms of bovine PMNL dysfunction during the periparturient period. In addition, several pathways by which supplementation with micronutrients may impact PMNL performance were discovered.