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Methane emission, metabolism, and performance of Holstein dairy cows with low, medium, and high lymphocyte proliferation during transition

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Abstract:

This study aimed to identify interactions between stat of lactation (dry or early lactating) and immune responder group (low, medium, or high) for energy metabolism traits as well as metabolic and immunological traits in dairy cows. In early lactation, when the energy priority of cows shifts toward the mammary gland, the energy available to be partitioned toward the immune system may differ among individuals. The equilibrium between energy supply from feed, digestion, and body reserve mobilization and energy expenditure with milk, immune system, methane, and heat production is delicate in this stage. Seventeen Holstein cows entering their second to fifth lactation were kept under comparable feeding, housing, and management conditions and were studied from 14 ± 6 d before calving to 11 ± 3 d after calving. Feed intake, milk yield, body condition, blood metabolites, and cortisol as well as gaseous exchange in respiration chambers were measured. The latter was used to quantify methane emission and to calculate resting metabolic rate and heat production. Subsets of blood leukocytes and peripheral blood mononuclear cells (PBMC) were monitored. Activation and proliferation of the PBMC in response to the mitogen phytohemagglutinin ante/and postpartum were assessed using the oxygen consumption rate (24-h cell culture assay) and the 3-(4,5-dimethylthiazol-2-yl)-2,5 diphenyl tetrazolium bromide (MTT) assay (72-h cell culture assay). Cows were classified based on the in vitro proliferative response of the PBMC measured postpartum in low (n = 6), medium (n = 5), and high (n = 6) responders. We found no interaction of state of lactation with responder group for feed intake, milk, yield, efficiency, metabolic traits, and immune cell activation ante- and postpartum. However, after calving, low-responder cows produced less methane per unit of body weight and per unit of energy-corrected ilk compared with the other cows. This might be indicative of a low rumen fermentation intensity. Low responders might therefore suffer from a lower availability of digestible energy in early lactation and not be able to sustain the shift from immune cell activation to proliferation. If so, the selection of environmentally friendly low-methane emitters could promote phenotypes with a compromised immune response in the critical early lactation.

Keywords: immune system, lymphocyte activation, mitogen, ruminant