UMR Herbivores

Team Biomarkers of performances, adaptation, and qualities (Biomarkers)

Feed restriction altered mammary and liver transcriptomes and proteomes after an inflammatory challenge in early-lactation cows, but had little effect on indicators of inflammation.

The energy deficit frequently observed in early-lactation induces a metabolic imbalance, and is associated with impaired immune function increasing the risk of mastitis. It may therefore have a high economic impact. To understand the mechanisms that regulate these changes, we studied the effects of a feed restriction on an induced inflammatory response. Our results showed that feed restriction modifies the metabolic responses to an intramammary inflammatory challenge. Nonetheless, 24 hours after the inflammatory challenge, the restriction had little effect on the expression of genes directly involved in immune function.

Dairy cows experience nutritional deficits in early-lactation (energy, protein and minerals). As a result, they must mobilize their body reserves, and may have altered metabolic profiles and immune function. Mastitis and metabolic disorders are frequent during the first weeks of lactation, leading to production losses, fertility problems and decreased functional longevity, which are costly in animal husbandry. The objective of this study was to investigate the effects of feed restriction on metabolic responses, mammary and hepatic transcriptomes and proteomes, during an inflammatory mammary challenge in early-lactation dairy cows.

We studied the effect of a negative energy balance (NEB) on the responses to inflammation induced by lipopolysaccharide (LPS) injection. We applied a feed restriction for 4 days (REST group; n=8) in comparison with a control diet (CONT group; n=9) in early-lactation dairy cows. Energy intake met 38 and 95% of requirements in REST and CONT, respectively. After 72 h of restriction, 50 µg LPS was injected into a healthy rear mammary quarter to induce an acute inflammatory reaction.
The nutritional deficit modified metabolic responses to the inflammatory challenge, probably due to changes in hormonal regulations and the limited availability of nutrients that support the inflammatory response. In addition, transcriptomic and proteomic studies of mammary gland and liver tissues showed changes in expression of genes involved in fatty acid and glucose metabolism and in protein synthesis. However, 24 h after the inflammatory challenge, the feed restriction had little effect on the expression of genes involved in immune function in the mammary gland and liver. This study contributed to a better understanding of the mechanisms linking metabolic stress and inflammatory response in early lactation dairy cows, and highlights transient effects of acute inflammation on mammary and liver tissues.

We plan to evaluate further the relationships between nutritional deficit, metabolic stress, inflammation and oxidative stress in early lactation dairy ruminants, as well as their contributions to individual robustness and efficiency. We will also focus on their regulatory mechanisms. We will conduct studies on a larger number and different breeds of animals. these experiments to identify new non-invasive indicators of nutritional and inflammatory status in dairy ruminants, and thus contribute to improve phenotypic robustness of the animals.

Publications

Pires, J., Pawlowski, K., Rouel, J., Delavaud, C., Foucras, G., Germon, P., Leroux, C. (2019). Undernutrition modified metabolic responses to intramammary lipopolysaccharide but had limited effects on selected inflammation indicators in early-lactation cows. Journal of Dairy Science, 102 (6), 5347-5360. , DOI : 10.3168/jds.2018-15446 https://prodinra.inra.fr/record/458701

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Contacts: Leroux Christine, christine.leroux@inra.fr ; Pires José, jose.pires@inra.fr, UMR Herbivores, F-63122 Saint Genès Champanelle, France