UMR Herbivores

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The structure of the rumen microbiota can be modulated by early interventions in the preruminant milk-feeding stage

Modulating the assembly of the ruminal microbiota might have practical implications in production. We tested how an early-life dietary intervention influences the diversity and function of the ruminal microbiota in lambs. The early-life intervention induced modifications in the rumen bacterial community that persisted even after the intervention ceased but had no significant effect on archaeal and protozoal communities. There was no persistency on methanogenesis indicating resilience for this function.

The colonization of the gastrointestinal track of newborns starts during birth and continues through successive waves of colonization and community changes until the microbiota reaches a stable state later in life. Various events may directly or indirectly modify the gastrointestinal microbiota composition. These modifications may be particularly significant early in life, during the period of successive colonization when the microbiota is less stable and comparatively simple with few dominant taxa. An important aspect that have been less studied is how microbial communities that were affected by disturbance events during their de novo assembly in young animals will react to the same type of disturbance later in life. Whether these communities will be more or less resilient is an important question in microbial ecology that has practical implications. For instance, the animal response to a dietary treatment could be different for phenotypes driven by the gut microbiota such as enteric methane emissions and forage digestibility depending on whether or not the microbial community was previously exposed.

We tested how an early-life dietary intervention in lambs influences the diversity and function of the ruminal microbiota during and after the intervention. The treatment, aiming to mitigate enteric methane emissions, combined garlic essential oil and linseed oil. Fifty-six lambs and their dams were allocated to two groups. Thetreatment (T) or the placebo (P) was drenched from birth until 10 weeks of life. From 16 to 20 weeks, the lambs from each group were divided in two subgroups that received or not the same treatment (T-T, T-P, P-P, P-T). The average daily gain was similar between groups. Methane emissions were reduced by the treatment at 8 and 20 weeks but at 14 weeks there were similar to those of animals receiving the placebo. Interestingly, early-life treated lambs displayed a numerical increase in methane emissions at 20 weeks compared with non-treated lambs. The treatment did not affect Volatile Fatty Acids (VFA) concentration at 8 or 14 weeks but decrease it at 20 weeks. Metataxonomics (rRNA gene) revealed differences in archaeal communities between groups of lambs when the treatment was applied (Weeks 8 and 20); whereas, in accord with methane emissions, these differences disappeared when treatment was discontinued (Week 14). Protozoal community structure was not affected by treatment. In contrast, bacterial community structure differed between treated and placebo lambs during and after the intervention. Rumen and urine metabolomics (LC-MS and NMR) at Week 20 separated lambs receiving the treatment vs. the placebo, and correlation analysis highlighted interactions between microbes and metabolites. This study demonstrates that a long-term early-life intervention induce modifications in the composition of the rumen bacterial community that persisted after the intervention ceased with no significant effect on archaeal and protozoal communities. However, there was no persistency of the early-life intervention on methanogenesis indicating resilience for this function.

Disturbances in the composition of the rumen bacterial community applied to lambs early in life induce modificationst hat persist after the disturbance ceased. Conversely, this does not result in changes in methanogenic archaea and protozoal communities. This could be due to the treatment applied or to microbial ecology laws associated to the diversity of these communities, i.e. low diversity for archaea and high diversity in protozoa. Also the production of methane remains stable, indicating resilience for this function. On the contrary, early-life treated lambs displayed a numerical increase in methane emissions compared to non-treated lambs. This merits to be confirmed as early-life priming may induce emergent properties in microbial communities that are opposed to the effect initially sought. The effect of microbiota modulation in early-life on other functions needs to be further explored.

Valorisation

Saro, C., U. M. Hohenester, M. Bernard, M. Lagrée, C. Martin, M. Doreau, H. Boudra, M. Popova, and D. P. Morgavi. 2018. Effectiveness of Interventions to Modulate the Rumen Microbiota Composition and Function in Pre-ruminant and Ruminant Lambs. Front Microbiol 9. 10.3389/fmicb.2018.01273

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