Evaluation of rumen-protected leucine supplementation in Holstein calves

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Compared with that in the rumen, starch digestion in the small intestine can provide 42% more energy. The starch digestibility in small intestine of ruminants is limited to 60% (Moharrery et al., 2014). We found that increasing the intestinal leucine flux enhanced the synthesis and secretion of pancreatic α-amylase and further increased small intestinal starch digestion in cannulated ruminants (Liu et al. 2015). However, the potential effect of the surgery on the pancreatic functions could not be ruled out (Ansia et al., 2019). Therefore, the objective of the present study was to evaluate rumen-protected leucine (RP-Leu) supplementation for its ability to improve small intestinal starch digestion in calves without the confounding factor of surgery.

Fourteen male Holstein calves (158 ± 19 kg of body weight) were randomly assigned to two groups with seven calves per group. The calves received basal diet only or the basal diet supplemented with 36 g/d RP-Leu respectively for 4 weeks. The first 21 d were adaptation period and the remaining 7 d were used for sampling. Blood samples were collected at 0, 2, and 4 h postfeeding on the first 2 d of the sampling period for analysis of plasma glucose, insulin and urea nitrogen. Faecal samples were obtained on the 3 to 5 d of the sampling period for analyses of the whole tract digestibility, faecal volatile fatty acid (VFA) profile, and microbial composition. Rumen fluid was collected via esophageal tube from each calf at 2 h and 4 h post-feeding on d 4 and d 5 of the sampling period for analysis of the ruminal VFA profile. The PROC GLM procedure of SAS version 9.1 was used to determine the differences in all the measures between the treatments.

RP-Leu did not affect rumen fermentation profile or whole-tract starch digestibility, but it increased blood glucose concentration and faecal pH and decreased faecal propionate molar proportion. RP-Leu increased fibrolytic genera *Ruminiclostridium* and *Pseudobutyrivibrio* and decreased the amylolytic genus of *Faecalibacterium* (Figure 1).

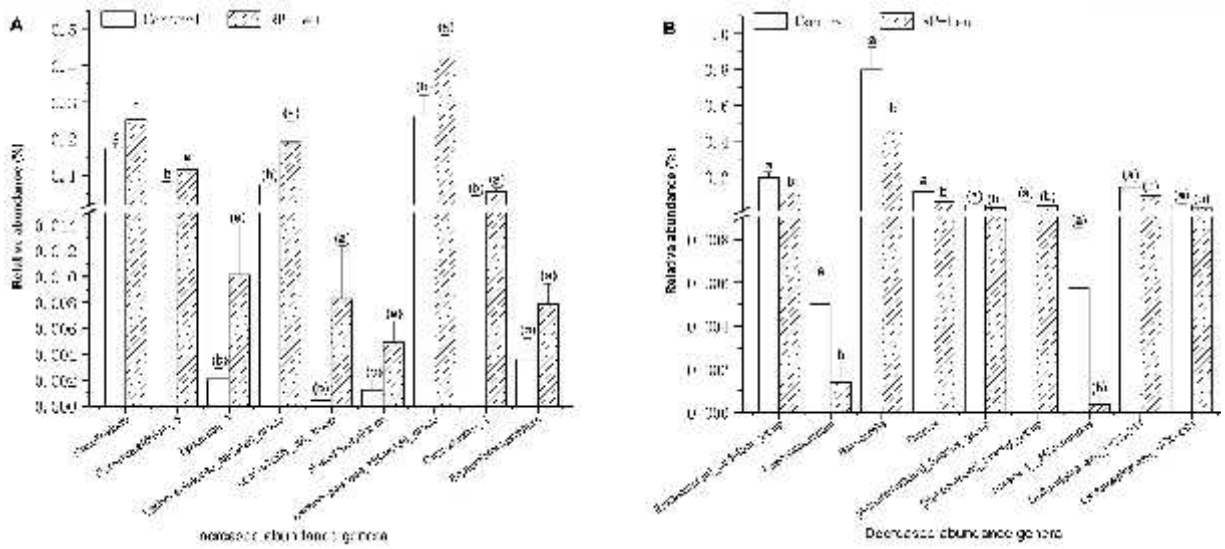

Figure 1. Genera of fecal bacteria with increased (A) or decreased (B) relative abundance in response to rumen-protected leucine (RP-Leu) supplementation.

Exogenous absorption and endogenous gluconeogenesis together contribute to blood glucose concentration, and the endogenous synthesis is largely from hepatic gluconeogenesis. The ruminal VFA profile was not affected by RP-Leu, hence, the increased blood glucose can be mainly contributed by the exogenous absorption of glucose from the small intestine. The decreased faecal excretion of propionate, increased relative abundance of faecal cellulolytic bacteria, and decreased relative abundance of amylolytic bacteria indicated that starch digestion in the hindgut was decreased. RP-Leu probably increased starch digestion in the small intestines, while decreasing the flow of starch from the small intestine to the hindgut. Overall, our results suggest that RP-Leu could stimulate starch digestion in the small intestine in calves.

References

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