O12 Comparison of jejunum and ileum electrogenic transport and epithelium integrity in growing cattle from three different crossbreeds

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Introduction

The integrity of the gastro-intestinal tract and the intestinal absorption of nutrients may contribute to inter-individual variation in feed efficiency in beef cattle (Kenny et al., 2018). The aim of this study was to compare the intestinal epithelium integrity and the jejunum and ileum electrogenic transport in growing heifers from three different crossbreeds.

Material and Methods

Ethics committee of Switzerland approved all the procedures. Thirty growing heifers from three crossbreeding (Brown Swiss as dam and Limousin, Angus or Simmental as sire, n = 10 of each) were used. After weaning at the age of 2.5 months (mo), animals were fed according to two type of grass-based diets and were slaughtered at different ages leading to five experimental treatments (n = 6 for each): Grass silage-based diet continuously, slaughtered at 200 ± 10 days old (GS-7mo); 350 ± 10 days (GS-11mo) or 470 ± 10 days (GS-15mo); or grass silage-based diet until 7 mo and pasture only thereafter, slaughtered at 290 ± 10 days (PA-9mo) or 350 ± 10 days (PA-11mo). Intestinal segments from jejunum and ileum (210 cm and 5 cm cranium from ileo-cecal valve, respectively) were removed within 50 min after slaughter.

To evaluate L-Glutamate (L-Glut), L-Arginine (L-Arg), L-Methionine (L-Meth) and D-Glucose (D-Glu) uptakes across intestinal tissues, jejunum and ileum segments were mounted on Ussing chambers. The trans-epithelial potential difference (TEER) and short-circuit current (Isc) were continuously monitored. Mucosal addition of 5 mM L-Glut was followed by the addition 15 min apart of L-Arg, L-Meth and D-Gluc at the same concentration.

The results were analyzed by ANOVA with the R software (v 4.0.5). Linear mixed-effects regression (lmer) models were used as mixed models. Model contained the crossbreed, tissue (jejunum vs ileum) and treatment as fixed effects and the animal as a random effect. The interactions crossbreed×tissue and tissue×treatment were evaluated, while the interactions crossbreed×treatment and crossbreed×tissue×treatment were not addressed due to the reduced number of observations. For pairwise comparisons, Sidak function was performed for a modified Tukey test for multiple comparisons of means. Means and SEM were reported from the lsmeans function from the package emmeans. Residuals of lmer models were checked for normality and homoscedasticity. For L-Glut and L-Meth, the values were logarithmic transformed.

Results and Discussion

Whatever the slaughter age and dietary treatment, the jejunum TEER of the Limousin crossbreed was higher ($P < 0.01$) compared to the jejunum and ileum of the Angus and Simmental crossbreeds. Conversely, none differences were observed according to crossbreed or treatment in the amino acids and D-Glu uptakes (Table 1). The L-Arg uptake was lower ($P = 0.01$) in GS-7mo compared to GS-11mo, whatever the tissue segment (Figure 1).

Conclusion and Implications

The TEER measurements constitute a method to monitor the barrier integrity of epithelial layers (Chen et al., 2015) and it mostly depends by tight-junctions integrity. The barrier function of tight-junctions regulates host nutrition, maintenance of homeostasis and protection of the host against pathogen invasion that can cause severe intestinal infection (Gareau et al., 2010). Therefore, based on these results, we speculate that the Limousin crossbred heifers could be less susceptible to gastrointestinal disorders and further analyses are planned to further investigate the differences between the three crossbreeds in the tight-junctions protein expression. The reasons and the implications of the increased L-Arg uptake for GS-11mo treatment and subsequent decrease after 4 mo on the same diet will be also the subject of future studies.

Table 1
Trans-epithelial resistance (Ω), amino acids and D-Glucose induced ΔIsc (μA) in the jejunum and ileum of Limousin, Angus and Simmental crossbred heifers.

	× Limousin		× Angus		× Simmental		SEM	*P*-values				
	Jejunum	Ileum	Jejunum	Ileum	Jejunum	Ileum		CB	T	CB × T	Tr	Tr × T
TEER	117[b]	70.5[a]	83.7[a]	63.1[a]	79.4[a]	58.4[a]	6.51	0.51	0.52	0.008	0.56	0.58
Glut	0.89	1.47	0.94	1.77	1.48	1.39	0.38	0.44	0.94	0.72	0.19	0.41
Arg	0.93	1.51	1.13	1.43	1.22	1.97	0.38	0.66	0.71	0.88	0.01	0.41
Meth	1.14	1.38	1.12	1.33	1.11	1.51	0.34	0.25	0.81	0.47	0.85	0.97
Gluc	1.07	1.65	1.51	1.85	1.38	1.19	0.32	0.49	0.95	0.94	0.25	0.64

[a,b] Means within a row with different superscripts differ significantly ($P < 0.05$). TEER: trans-epithelial resistance; Glut: L-glutamate; Arg: L-arginine; Meth: L-methionine; Gluc: D-glucose; CB: crossbreed; T: tissue segment; Tr: treatment.

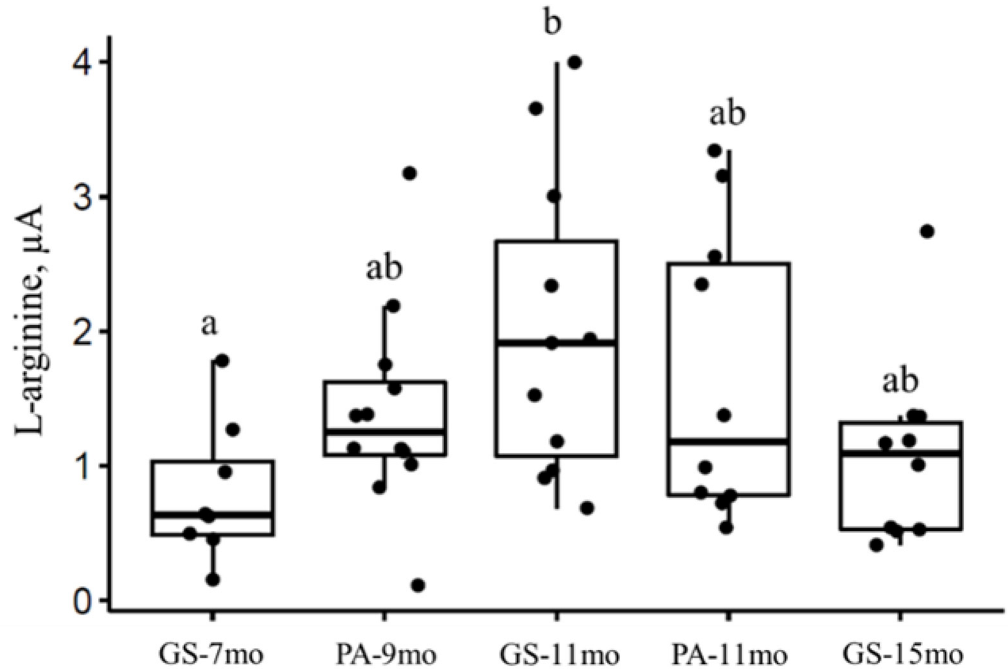

Figure 1. L-Arginine uptake (µA) in the intestine (jejunum and ileum) of the three crossbreeds depending by the treatment. Abbreviations: GS-7mo: Grass silage-based diet, slaughtered at 200 days old; GS-11mo: Grass silage-based diet, slaughtered at 350 days old; GS-15mo: Grass silage-based diet, slaughtered at 470 days old; PA-9mo: grass silage-based diet until 7 mo and pasture only thereafter, slaughtered at 290 days old; PA-11mo: grass silage-based diet until 7 mo and pasture only thereafter, slaughtered at 350.

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O13 Changes of amino acid profile in serum and milk in dairy cows under feed restriction and re-feeding

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Introduction

Experimental feed restriction models are used to induce negative energy balance (NEB) and assess the production and metabolic responses to evaluate their effects on various biological functions of the dairy cow (Billaet al., 2020). In addition to the classical energy metabolic changes that occur during NEB, it has also been shown that the distribution and use of amino acids (AA) are modified (Apelo et al., 2014) and their blood plasma concentration decreased in dairy cows under feed restriction (Ansia et al., 2020). It is known that branched-chain amino acids (BCAA) play important roles in the metabolic regulation of AA and enhance protein synthesis through the mammalian target of rapamycin (mTOR) signaling pathway (Webb et al., 2020). However, there is little information on the effects of feed restriction on changes in AA metabolism, especially BCAA. Therefore, the aim of this study was to assess the effect of feed restriction on blood serum and milk AA profiles, particularly BCAA.