

Physiological adaptations of the gastrointestinal tract in suckling calves

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INTRODUCTION

During the rearing phase, the calf is physiologically non-ruminant. Following microbial colonization of the gastrointestinal tract (GIT), fermentative processes commence, leading to the production of short-chain fatty acids (SCFAs) and branched-chain fatty acids (BCFAs), albeit at lower concentrations compared to the adult bovine rumen.

OBJECTIVES

The aim was to evaluate age-related physiological adaptations of the GIT in calves.

MATERIAL AND METHODS

Nine male Holstein calves were housed in individual suspended cages of 3m² in a controlled environment at the Calf Research Laboratory of FMVZ/USP. A liquid diet ($\geq 12.5\%$ total solids) was provided at a volume of 3L in two feedings (6L/day), with water *ad libitum*. At 25 days, calves began consuming 300g of starter feed with 22% crude protein (AgMilk, Agrocere[®]) *ad libitum*, with a 10% leftover allowance. Daily diarrhea scores were recorded, and fecal samples were collected on days: 7, 21, 35, 49, and 63. Gas chromatography divided samples for pH, dry matter (DM), and SCFAs and BCFAs measurement. Time analysis was performed using analysis of variance (ANOVA, $P \leq 0.05$).

RESULTS AND DISCUSSION

The mean fecal pH (**Figure 1**, $P < 0.0001$) increased from day 7 (5.42 ± 0.19) to day 21 (6.64 ± 0.14) and remained similar until day 63. Fecal DM (**Figure 2**, $P = 0.0567$) showed a trend of difference over the experimental period, with a reduction at day 21, which correlated with the higher frequency of diarrhea during this period. Total SCFA concentration (**Table 1**) also showed a trend ($P = 0.0526$), with initial moments on an exclusively liquid diet being similar and lower than the subsequent evaluated times. The acetate:propionate (C2:C3) ratio was very high on day 7 and tended to decrease over time ($P < 0.0001$), as expected for suckling animals. The molar proportion of all BCFAs decreased, however, isovalerate increased from day 7 to day 21 ($P < 0.0001$). Valerate ($P = 0.6504$) and isobutyrate ($P = 0.1023$) remained stable during the study.

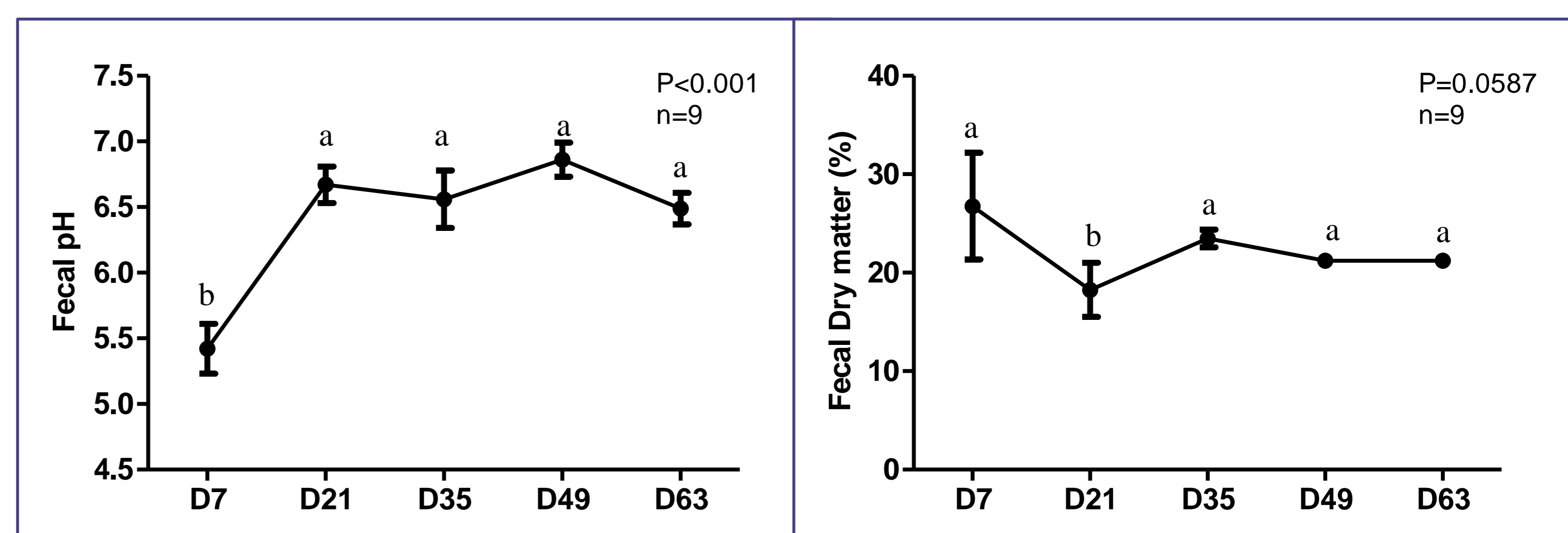


Figure 1. Fecal pH of nine Holstein suckling calves from 7th to 63rd days of life. **Figure 2.** Fecal dry matter (%) of nine Holstein suckling calves from 7th to 63rd days of life.

Table 1. Fecal fermentative parameters by SCFA and BCFA concentration and molar ratio of nine Holstein suckling calves from 7th to 63rd days of life.

	D7	D21	D35	D49	D63	P-VALUE
TOTAL SCFA (mM)	17.95 ± 4.05a	16.91 ± 9.47a	24.16 ± 6.13a	21.88 ± 7.56a	24.99 ± 5.38a	0.0526
SCFA (mM/100mM)						
ACETATE (C2)	80.11 ± 9.93a	54.74 ± 7.11b	57.45 ± 4.86b	62.89 ± 5.39b	61.89 ± 1.84b	<0.0001
PROPIONATE (C3)	8.20 ± 6.31a	18.57 ± 8.15b	21.29 ± 3.28b	20.69 ± 4.21b	20.84 ± 3.06b	<0.0001
BUTYRATE	7.97 ± 8.24a	16.22 ± 4.07bc	15.20 ± 4.69bc	10.56 ± 4.75ac	12.22 ± 2.51ac	0.0107
RATIO C2:C3	16.08 ± 11.22a	4.41 ± 4.16b	2.76 ± 0.52b	3.21 ± 1.05b	3.03 ± 0.51b	<0.0001
BCFA (mM/100mM)						
ISOBUTYRATE	1.69 ± 1.89a	3.66 ± 3.37a	1.65 ± 0.56a	1.65 ± 0.32a	1.65 ± 1.38a	0.1023
ISOVALERATE	0.12 ± 0.37a	3.83 ± 2.24b	2.06 ± 0.64bc	1.97 ± 0.53bd	1.35 ± 0.58a	<0.0001
VALERATE	1.88 ± 1.28a	2.96 ± 2.66a	2.32 ± 1.33a	2.22 ± 1.19a	2.03 ± 0.71a	0.6504

Lowercase letters denote differences among time points ($P \leq 0.05$)

CONCLUSION

It was concluded that fecal pH, DM, and SCFAs/BCFAs concentration were influenced by the age and diet of the calves, with significant changes after the introduction of starter feed.

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