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Both high-starch and low-starch concentrates can develop the rumen function of unweaned dairy calves

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Introduction

- Our initial hypothesis was that an alternative low-starch, high-fiber, and high-sugar calf-starter would prevent acidification of the rumen but still maintain its efficacy in stimulating reticulo-rumen development and calf growth.
- Traditional calf-starters with high contents of easily fermentable starch induce an acidic ruminal environment as soon as the young calf begin to eat concentrate (*Kristensen et al., 2007 J. Dairy Sci. 90, 4346-4355*).
- However, the beneficial effect of the alternative calf-starter was only seen when calves at the same time was eating a high amount of grass hay (*Kristensen et al., 2006, J. Dairy Sci. 89, Suppl. 1, 365, Abstract*)
- In another experiment, we found that rumen pH and rumen development was similar if calves fed the alternative concentrate ate only half the amount of hay compared with calves fed a traditional concentrate (*Vestergaard et al., 2008, J. Anim. Sci. 86, E-Suppl. 2, 67, Abstract*).

Objective

- To evaluate the consequences of using an alternative low-starch concentrate compared with a traditional high-starch concentrate on rumen papillae development and growth performance when fed as only dry feed to milk-fed calves from 2 to 6 weeks of age

Materials and Methods

- Eight new-born Friesian calves in 2 blocks of 4 calves
- Implanted with a ruminal cannula at 1-2 wk of age
- From d 4 calves were fed 4.84 kg/d of skim milk-based milk-replacer (610 g powder/d) in two meals
- Calves were individually housed in pens with no bedding and no access to hay
- **Treatments** (1):
  - **TRA:** traditional high-starch concentrate
  - **ALT:** alternative low-starch high-fibre concentrate

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	TRA	ALT
Cereals, %	57.0	16.2
Grass pellets, %	2.5	30.0
Sugar beet pulp, %	3.4	24.0
Beet molasses, %	3.0	6.0
Per kg DM:		
Protein, g	211	199
Starch, g	349	106
Sugars, g	60	112
Cell walls, g	180	360
ME, MJ	14.2	13.4

- Ingredients were ground and made into pellets (Ø=3.5 mm)
- Rumen fluid (12 samples/24 h) was obtained in wks 2-3, 3-4, 4-5, and 5-6 for immediate pH measurement
- Calves were killed at 5 to 6 wks of age (40±1 d) and rumen papillae measured
- A fixed area (Ø=9.7 cm) of rumen epithelium stripped from muscles was obtained and dried (DM%: 19-20)

Results

- Rumen pH was lower in ALT compared with TRAD (2, 3).
- However:
  - Two TRAD-calves had very low concentrate intake (28 g/d), high rumen pH, and weak papillae development.
  - Excluding these two calves reduced most treatment differences, but rumen pH was still lowest in ALT fed calves.

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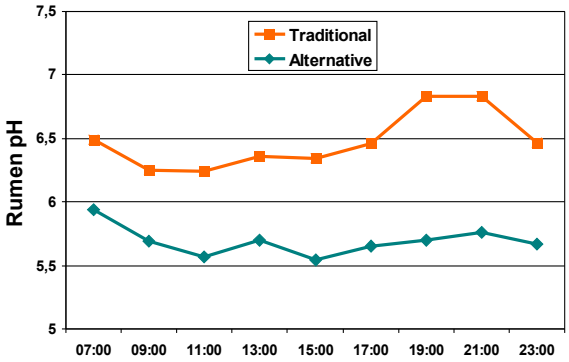

Rumen pH in week 3-4 from 4 calves fed a traditionally high-starch and 4 calves fed an alternative low-starch concentrate
(The effect of time of day was P<0.001)

- Growth rate was low (≈400 g/d) in both TRA and ALT calves (3)
- Rumen papillae length and shape suggested better rumen development in ALT compared with TRAD calves (3)

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	TRA	ALT	*P-value*
Number of calves	4	4	
Concentrate intake, g/d	141	245	ns
ADG, g/d	380	438	ns
Rumen variables:			
Average pH (wks 2-5)	6.32	5.61	0.02
Weight, g	476	655	ns
Papillae length, mm	0.76	1.74	0.05
Atrium papillae length, mm	1.0	2.4	0.10
Atrium papillae shape[1]	1.4	2.7	0.07
Epithelium, g DM/cm^2	0.013	0.019	ns

[1]Shape 1-4; 1=short and lean or pointed, 2=short and leaf-shaped, 3=long and lean, and 4=long and leaf-shaped

Conclusion

In unweaned calves fed only milk and concentrate:

- Not only a traditional high-starch but also an alternative low-starch concentrate induced acidotic conditions in the rumen
- Alternative compared with traditional concentrate affected rumen development positively
  - However, at the same level of concentrate intake, rumen development was not different between the two types of concentrates
- Feeding no roughage resulted in some abnormal rumen-wall conditions and compromised growth performance

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