



Effect of Dietary Starch Content on the Occurrence of Subacute Ruminal Acidosis (SARA) and Inflammation in Fresh Dairy Cows

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INTRODUCTION

- Dietary strategies used during the transition period to optimize milk production and health in early lactation dairy cows continue to evolve
- A common strategy is to provide more fermentable carbohydrates in the form of starch in the fresh diet relative to the close-up diet
- Large changes in dietary composition and intake during the transition period may increase the susceptibility of cows to SARA, inflammation, and metabolic disorders especially when controlled energy, low-starch dry diets are used

OBJECTIVE

- To assess the impact of dietary starch fed to fresh dairy cows on rumen fermentation, rumination, energy metabolites, and inflammatory markers

MATERIALS AND METHODS

Experimental Design

- Randomized design with 16 multiparous Holstein cows
 - Fed treatments (Table 1) once daily from calving to 21 DIM in a Calan Broadbent Feeding System
 - **Lower starch diet** (21% starch, 37% NDF)
 - **Higher starch diet** (27% starch, 32% NDF)
- Managed similarly during the 55-d dry period with a close-up diet fed for 21 d before expected calving
- Housed in a bedded pack and milked 3x daily

Data Collection

- Intake was recorded daily from -14 to 21 DIM
- Milk yield was recorded daily and milk composition measured weekly from 1 to 21 DIM
- Rumen pH was measured at 1-min intervals and rumination was measured at 2-h intervals from -14 to 21 DIM
- Rumen fluid and blood were collected on -14, 1, 2, 3, 4, 5, 6, 7, 9, 13, 17, and 21 DIM at 0 and 6 h post feeding

Table 1. Ingredients and chemical composition of diets

Item	Close-Up	Lower	Higher
	Dry	Starch	Starch
Ingredients, % of ration dry matter			
Conventional corn silage	40.9	28.3	28.3
Haycrop silage	14.7	21.7	21.7
Straw	17.2	2.0	2.0
Corn meal	1.4	13.8	23.6
Soybean hulls	-	6.5	-
Wheat middlings	-	3.3	-
Soybean meal	9.8	8.8	8.8
AminoMax	6.9	6.7	6.7
Canola meal	-	3.3	3.3
Other	9.1	5.6	5.6
Analyses, % of ration dry matter			
Crude protein, %	16.3 ± 0.1	16.7 ± 0.2	16.1 ± 0.1
Crude detergent fiber, %	27.0 ± 0.3	22.0 ± 0.4	18.8 ± 0.3
Neutral detergent fiber, %	43.8 ± 0.3	36.5 ± 0.3	31.7 ± 0.4
Acid detergent lignin, %	4.3 ± 0.1	3.5 ± 0.1	3.4 ± 0.1
Starch, %	15.5 ± 0.2	21.3 ± 0.3	27.2 ± 0.5
Sugar, %	3.8 ± 0.2	4.9 ± 0.3	5.1 ± 0.3
Fat, %	2.8 ± 0.1	3.4 ± 0.1	3.3 ± 0.1

Statistical Analysis

- ANOVA with the MIXED procedure of SAS with model effects of diet, time, diet x time, and covariate

RESULTS

Table 2. Characterization of intake and lactational performance

Item	Lower	Higher	SE
	Starch	Starch	
Close-up DMI, kg/d		13.7	0.3
Fresh DMI, kg/d	20.0	20.8	0.7
Fresh DMI, % of BW	2.74	2.86	0.10
Milk, kg/d	40.2	43.9	1.9
Milk fat, %	4.67	4.61	0.17
Milk true protein, %	3.59	3.46	0.07
MUN, mg/dL	17.3	13.6	0.8

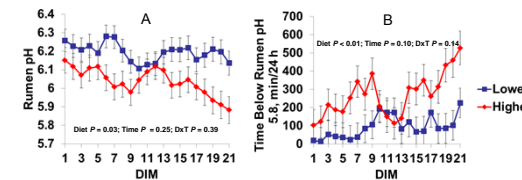


Figure 1. Rumen pH expressed as daily mean pH (A) and time with pH < 5.8 (B)

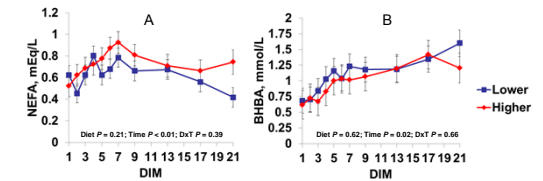


Figure 2. Energy metabolites expressed as 0-h serum NEFA (A) and 0- and 6-h whole blood BHBA (B)

Table 3. Rumination, rumen fermentation, and plasma cytokines

Item	Lower	Higher	SE	Diet P	Time P	Diet x Time P
	Starch	Starch				
Rumination, min/d	468	494	18	0.30	<0.01	0.46
Rumen (0- and 6-h)						
Ammonia, mg/dL	10.1	7.1	0.6	<0.01	<0.01	0.53
VFA, mM	117	114	3	0.52	0.19	0.16
Acetate, mol/100 mol	63.3	62.1	0.6	0.18	0.11	0.31
Propionate, mol/100 mol	19.3	20.3	0.7	0.31	0.10	0.49
Butyrate, mol/100 mol	10.3	10.6	0.3	0.40	<0.01	0.40
Acetate:Propionate	3.33	3.13	0.10	0.28	0.09	0.62
Plasma (6-h)						
IL-1β, pg/mL	57.9	56.6	5.1	0.85	0.93	0.97
IL-6, pg/mL	499	415	42	0.16	<0.01	0.64
TNFα, pg/mL	41.7	39.7	2.7	0.59	0.15	0.69

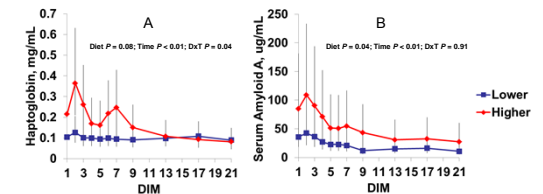


Figure 3. Acute phase proteins expressed as 6-h serum haptoglobin (A) and 6-h serum amyloid A (B). Error bars are 95% confidence intervals.

CONCLUSIONS

- Fresh cows fed a higher starch diet following a controlled-energy, lower-starch close-up diet had a lower daily mean rumen pH, more SARA, and higher serum acute phase proteins
- Feeding strategy during the transition period is critical for minimizing the risk of SARA and controlling inflammation