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Effects of Acidified Fermentation By-Products and Prepartum DCAD on Feed Intake, Performance, and Health of Transition Dairy Cows

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Summary
Two commercially available acidified fermentation by-products were evaluated in the close-up period (21 days before expected calving) for their effects on feed intake, postpartum performance, and cow health. Diets were formulated to contain similar protein and energy values but differed in dietary cation anion difference and anion source. Treatments were Bio-Chlor, SoyChlor, and a control. Prepartum feed intake tended to be lower for SoyChlor than for the control, but postpartum intake did not differ among dietary treatment groups. Likewise, no significant differences were detected for milk yield between treatments. Protein percentage, milk urea nitrogen, and lactose percentage were greatest for SoyChlor-treated cows. Therefore, despite a trend for a negative effect on prepartum feed intake, SoyChlor supported similar productivity in early lactation.

Introduction
Near the time of calving and subsequent onset of lactation, most high-producing dairy cows will experience some degree of hypocalcaemia. Although only clinical hypocalcemia (milk fever) cases are typically detected, ramifications of subclinical hypocalcaemia can reach far into the lactation of the cows affected. Studies show that cows that suffer from hypocalcemia have a much greater susceptibility to other transition disorders such as retained placenta, metritis, mastitis, ketosis, and displaced abomasum. In addition, cows may suffer from decreased milk production and impaired reproductive function long after the transition period has passed.

Preventing hypocalcemia in transition dairy cows has been the subject of much research. Traditional methods used to prevent hypocalcemia have limited calcium intake during the dry period by formulating low-calcium diets. Unfortunately, this strategy proves difficult when diets are formulated with typical feedstuffs found on dairies for transition cow nutrition. Another well-proven and more feasible option is lowering the dietary cation anion difference (**DCAD**) balance [(Na + K)-(Cl + S)] in the diet during the last 21 days before expected calving. Although it is possible to achieve this goal without using feed additives, this generally does not allow for use of forages grown on the farm because they are high in potassium. To achieve a negative DCAD balance, anionic salts [$MgSO_4$, $MgCl_2$, NH_4Cl_2, $(NH_4)_2SO_4$, $CaCl_2$, and $CaSO_4$] have been incorporated in close-up rations. Introducing anions into the prepartum diet creates a mild state of metabolic acidosis that increases the sensitivity of tissues to parathyroid hormone, a key regulator of calcium homeostasis.

In addition to improving postpartum calcium status when fed in the close-up period, anionic salts have been found to decrease feed intake at a time when energy status of the animal is key. The need for a more palatable supplement that still has the ability to decrease DCAD in the diet led to the creation of acidified fermentation by-products (**AFBP**). The AFBP are treated with hydrochloric acid to add chloride ions but are marketed as having fewer negative effects on feed intake than anionic salts.

Experimental Procedures

The objective of this study was to compare the effects of 2 commercial AFBP on prepartum and postpartum feed intake, milk production, and postpartum health disorders. Diets differed in DCAD and source of anionic supplement. Treatments were a control (**CON**; DCAD = +20 meq/100 g dry matter; 9 cows and 4 heifers), Bio-Chlor (**BC**; Arm & Hammer Animal Nutrition, Princeton, NJ; DCAD = −10 meq/100 g dry matter; 8 cows and 6 heifers), and SoyChlor (**SC**; West Central Cooperative, Ralston, IA; DCAD = −10 meq/100 g dry matter; 9 cows and 6 heifers). Treatment diets (Table 1) were fed ad libitum from 21 days before the expected calving date until parturition. After parturition, all cows received a single fresh cow total mixed ration and were fed for ad libitum intake. Cows remained in a tie-stall facility until 14 days in milk and then were moved to a freestall facility, where they continued to receive the same lactation ration. Milk yield was recorded daily through 21 days in milk, and milk samples were collected daily between 5 and 21 days in milk.

A total of 45 cows and heifers were included in the study; however, 3 (all multiparous cows) were removed because of health events unrelated to treatment. Data were analyzed by using mixed models including the fixed effects of treatment, parity, day relative to parturition, day by treatment interaction, parity by treatment interaction, and day by parity by treatment interaction, as well as the random effect of animal. Prepartum and postpartum feed intake were analyzed separately. Incidence of periparturient disorders was modeled by Fisher's exact test.

Results and Discussion

Feed Intake, Milk Yield, and Composition

A summary of prepartum and postpartum feed intake (as-fed), milk yield, and milk composition is shown in Table 2. When dietary treatments were fed (the prepartum period), SC tended ($P = 0.09$) to decrease feed intake compared with CON, whereas BC was intermediate. Postpartum intake did not differ among treatments. Treatment means for protein percentage, lactose percentage, and milk urea nitrogen differed ($P < 0.05$), with SC increasing concentrations of all 3 milk components compared with BC.

Weight, Body Condition, and Postpartum Health Disorders

Changes in body weight and body condition score did not differ among treatments but decreased during the transition to lactation (Table 3). Clinical ketosis was identified with urinary ketone reagent strips, and cows that tested moderate or greater on the colorimetric scale for 2 consecutive days were deemed clinical cases. Incidences of displaced abomasum, retained placenta, metritis, mastitis, and milk fever were recorded according to standard clinical definitions. Incidences of all postpartum health disorders did not differ among treatments according to Fisher's exact test (Table 4).

Anionic salts are known to depress feed intake when incorporated into close-up rations, and AFBP are intended to minimize this problem. The SC treatment in this study, however, tended to decrease feed intake by 17% compared with the CON diet, which had a positive DCAD value. Feed intake of cows in the BC treatment was similar that of CON cows but did not differ from that of SC-treated cows. Milk production in early lactation, however, was not adversely affected by the trend for decreased prepartum feed intake in SC-treated cows.

Because even subclinical hypocalcaemia is associated with increased risk of numerous transition cow disorders, feeding a close-up ration with a positive DCAD, like the CON treatment, would be expected to cause more problems in early lactation. We did not observe a significant increase in incidence of disorders in this study, but the number of cows was quite small for determining such effects. Future analysis of blood calcium, glucose, and ketone concentrations may provide greater insight into the effects of DCAD treatments on metabolic health in early lactation.

Table 1. Ingredient composition of experimental diets

	Prepartum dietary treatment			Lactation
Ingredient (% of diet dry matter)	Control	Bio-Chlor	SoyChlor	diet
Corn silage	25.2	25.1	25.1	23.8
Wheat straw	35.9	35.9	35.8	—
Wet corn gluten feed	11.0	11.0	11.0	32.4
Alfalfa hay	—	—	—	12.1
Rolled corn	10.6	10.5	10.6	19.4
Soy hulls	4.8	4.5	1.6	1.8
Soybean meal	9.9	5.2	8.5	—
SoyBest	—	—	—	6.2
Blood meal	0.8	0.8	0.8	—
Bio-Chlor	—	5.3	—	—
SoyChlor	—	—	6.1	—
Molasses	0.4	0.4	0.4	—
Micronutrient premixes	1.7	1.7	0.5	4.2

Table 2. Dietary treatment effects on feed intake and performance

	Prepartum dietary treatment				*P* value		
Item	Control	Bio-Chlor	Soy-Chlor	SEM	Day	Parity	Diet
Prepartum feed intake, lb/day	40.2	37.9	33.4	2.7	<0.001	0.68	0.09
Postpartum feed intake, lb/day[1]	44.0	46.6	50.9	5.5	<0.001	0.24	0.63
Milk yield, lb/day[2]	70.3	74.7	76.2	5.3	<0.001	<0.01	0.70
Energy-corrected milk, lb/day	77.8	82.8	82.0	5.1	0.08	<0.001	0.74
Fat yield, lb/day	2.91	3.22	2.95	0.18	0.13	<0.001	0.41
Fat, %	4.33	4.46	4.01	0.002	<0.001	0.03	0.27
Protein yield, lb/day	2.23	2.23	2.49	0.19	<0.01	<0.01	0.46
Protein, %	3.18	2.99	3.29	0.001	<0.001	0.55	0.03
Lactose yield, lb/day	3.35	3.50	3.70	0.28	<0.001	<0.01	0.62
Lactose, %	4.70	4.66	4.87	0.001	<0.01	0.08	0.02
Somatic cell count	162	131	107	68	0.98	0.40	0.86
Milk urea nitrogen, mg %	8.82	8.57	9.11	0.12	<0.001	0.19	<0.01

[1]Through 14 days in milk.
[2]Through 21 days in milk.

Table 3. Effects of dietary treatment on body weight and body condition score

	Prepartum dietary treatment				*P* value		
Item	Control	Bio-Chlor	Soy-Chlor	SEM	Day	Parity	Diet
Weigh, lb	1369	1505	1479	49	<0.001	<0.001	0.12
Body condition score	3.10	3.15	3.20	0.08	<0.001	0.04	0.68

Table 4. Incidence of postpartum health disorders[1]

	Prepartum dietary treatment		
Item	Control	Bio-Chlor	SoyChlor
Number of cows	13	14	15
Ketosis	7	6	4
Displaced abomasum	3	1	2
Retained placenta	2	0	1
Metritis	1	0	0
Mastitis	1	1	0
Milk fever	1	1	0

[1]No significant treatment effects were detected using Fisher's exact test.