Effect of anionic salt source on peripartal dry matter intake, milk production, and blood mineral concentrations in Holstein cows

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ABSTRACT M202

Our objective was to compare the effects of two anionic salt sources on DMI, milk production, and blood mineral concentrations in periparturient cows. Multiparous cows (n=56) were balanced by parity and assigned to prepartum diets containing either 1) a commercially-formulated sulfur-based anionic salt pellet (PEL), or 2) a blend of individual anionic salts (IND). Prepartum diets differed only in anionic salt source and were balanced to achieve a dietary cation-anion difference of -10 mEq/100 g DM and to provide 150 g of calcium per cow per day. Cows were fed their respective prepartum diets from d 21 before expected calving date until calving. After calving, all cows were fed a lactation diet until d 56 in lactation. Prepartum DMI was not different (P = 0.26) between cows fed PEL or IND (13.1 vs. 12.2 kg/d). Postpartum DMI was not influenced (P=0.29) by prepartum treatments. Prepartum urine pH was lower (P < 0.01) for IND (7.13) than for PEL (7.95). Peripartal plasma Ca was not different (P = 0.16) between cows fed PEL compared with IND (9.5 vs. 9.7 mg/dL). Concentrations of P, Na, and K in plasma and Mg in serum did not differ (P > 0.05) between prepartum treatments around calving, although plasma Cl was higher (P = 0.04) for IND compared with PEL. From d -4 to 0 relative to calving, serum NEFA and plasma BHBA were higher (treatment x time; P<0.01) in cows fed PEL than in those fed IND, although postpartum NEFA and BHBA were not different (P > 0.90) between treatments. The PEL group tended (P = 0.06) to have higher prepartum body condition score (BCS) compared with the IND group. Prepartum treatment had no effect on postpartum milk yield, milk fat, milk protein, body weight, or BCS. Cows fed PEL tended to have a lower (P = 0.09) milk lactose concentration than cows fed IND (4.73 vs. 4.80%). The individual anionic salt blend reduced urine pH more than the sulfur-based pellet, however, cows fed PEL maintained sufficient blood Ca concentration around calving (>8 mg/dL). Therefore, PEL was effective in maintaining Ca homeostasis and preventing hypocalcemia.

Keywords: anionic salt, DCAD, periparturient period

INTRODUCTION

▪Hypocalcemia increases risk for developing other metabolic disorders such as mastitis, retained placenta, displaced abomasum, and ketosis (Goff and Horst, 1997).

▪Subclinical hypocalcemia (serum Ca ≤ 8.0 mg/dL) may render the cow more susceptible to secondary disorders, although clinical signs are absent (Horst et al., 2003).

▪A recent study reported that 51.9% of multiparous cows experienced subclinical hypocalcemia within 2 days after parturition (Horst et al., 2003).

▪Additionally, cows with normal serum calcium levels had lower serum NEFA (Horst et al., 2003).

▪Rations balanced to negative dietary cation-anion difference (DCAD) reduced the incidence of subclinical hypocalcemia (Horst et al., 2003).

▪A commercially-formulated sulfur-based anionic salt pellet fed prepartum has been shown to increase serum Ca concentration, reduce plasma NEFA, and increase milk yield compared with an unsupplemented control group (Spain et al., 2004).

▪Based on results from field studies (Technical Service Bulletin #292, #307, and #308; Dawe's Laboratories), serum Ca was poorly correlated with urine pH when a sulfur-based anionic salt pellet was fed; however, serum Ca was maintained above 8 mg/dL.

OBJECTIVES

▪To compare the effects of a <u>commercially-formulated sulfur-based anionic salt pellet</u> versus a <u>blend of individual anionic salts</u> on dry matter intake, milk production, cow health, and concentrations of metabolites and minerals in blood of periparturient dairy cows.

▪To examine the relationship between urine pH and plasma Ca when feeding a sulfur-based anionic salt product.

MATERIALS AND METHODS

▪**Design**
- ▪Fifty-six multiparous cows (entering 2nd lactation or greater)
- ▪Assigned to prepartum treatment according to parity and previous ME milk yield

▪**Treatments and Rations**
- ▪PEL – sulfur-based anionic salt pellet
- ▪IND – blend of individual anionic salts
- ▪Prepartum rations – d -21 until calving
  - ▪Balanced to provide 150 g/d calcium
  - ▪Balanced for a DCAD of -10 mEq/100 g DM
- ▪Lactation ration – fed from calving until 56 days in milk

▪**Data Collection**
- ▪Blood minerals
  - ▪Ca, P, K, Na, Cl (plasma); sampled on d -22, -13, -7, - 3 to +3 (daily), +7, and +13
  - ▪Mg (serum); sampled on d -3 to +3 (daily)
- ▪Blood metabolites
  - ▪NEFA (serum), glucose, cholesterol, BHBA (plasma); sampled on d -22, -19, -16, -13, -10 to +10 (daily), +13, +16, +19, and +21 to +56 (weekly)
- ▪Dry matter intake
  - ▪Daily
- ▪Body weight (BW) and body condition score (BCS)
  - ▪Weekly
- ▪Urine pH
  - ▪Twice weekly

▪**Statistical Analysis**
- ▪Proc MIXED of SAS with repeated measures
- ▪Fixed effects: treatment, time, and treatment*time interaction
- ▪Random effects: cow(treatment)
- ▪Means separated with PDIFF statement in SAS when interaction was significant

Table 1. Ingredient and nutrient composition of experimental rations.

	Diet[1]		
Item	PEL	IND	LACT
<u>Ingredient</u>	------------% of dry matter------------		
Corn silage	36.38	36.37	34.16
Alfalfa haylage	13.64	13.64	12.66
Wheat straw	9.10	9.09	1.61
Corn, ground	15.33	14.64	19.22
SBM, 48% CP	9.55	9.91	6.40
SBM, expeller[1]	----	----	8.50
Soyhulls	9.09	9.09	6.35
Cottonseed	----	----	6.40
Fat[2]	----	----	1.49
Sodium bicarbonate	----	----	1.07
Magnesium oxide	0.27	0.14	0.21
Limestone	1.68	1.36	1.17
Dicalcium phosphate	0.68	0.68	0.32
Salt	0.23	0.23	0.21
Anionic salt pellet[4]	4.05	----	----
Wheat midds	----	1.77	----
Magnesium sulfate	----	1.14	----
Calcium sulfate	----	0.55	----
Ammonium chloride	----	0.43	----
Calcium chloride	----	0.43	----
Mineral/vitamin premix	----	0.23	0.21
Vitamin A	----	0.03	----
Vitamin D	----	0.07	----
Vitamin E	----	0.20	0.02
<u>Nutrient</u>			
CP, %	12.98	12.48	15.84
ADF, %	26.73	27.68	24.81
NDF, %	41.29	42.68	39.33
NE_L, mcal/kg DM[5]	1.50	1.46	1.76
Ca, %	1.58	1.58	1.08
P, %	0.42	0.40	0.43
Mg, %	0.40	0.39	0.35
K, %	1.45	1.46	1.44
S, %	0.45	0.42	0.18
Na, %	0.13	0.14	0.43
Cl, %	0.80	0.85	0.29
DCAD, meq/100 g DM[5,6]	-9.48	-9.26	31.75

[1]PEL=anionic salts supplied by commercially-formulated sulfur-based pellet; IND=anionic salts supplied by a blend of individual anionic salts; LACT=lactation ration.

[2]SoyPlus (West Central Soy, Ralston, IA).

[3]Energy Booster 100; Milk Specialties, Inc., Dundee, IL.

[4]Dawe's Laboratories, Arlington Heights, IL.

[5]Estimated (NRC, 2001).

[6]Dietary cation-anion difference; (Na + K) – (Cl + S).

Table 2. Effect of anionic salt source on DMI, BW, BCS, and urine pH.

Item	Treatment[1] PEL	IND	SEM	*P*-value Treatment	Treatment*Time
Prepartum (-21 d to calving)					
DMI, kg/d	13.1	12.2	0.5	0.26	0.68
BW, kg	784	760	17	0.31	0.75
BCS, 1-5 scale	3.55	3.36	0.07	0.06	0.70
Urine pH	7.95	7.13	0.11	<0.01	0.49
Postpartum (calving to d 56)					
DMI, kg/d	20.6	21.4	0.5	0.29	0.75
BW, kg	663	655	13	0.64	0.55
BCS, 1-5 scale	2.69	2.64	0.05	0.44	0.45

[1]PEL=anionic salts supplied by commercially-formulated sulfur-based pellet;
IND=anionic salts supplied by a blend of individual anionic salts.

Table 3. Effect of anionic salt source on milk yield and milk composition

Item	Treatment[1] PEL	IND	SEM	*P*-value Treatment	Treatment*Time
Milk yield, kg/d	36.4	36.7	1.3	0.86	0.24
3.5% FCM[2], kg/d	40.9	39.9	1.6	0.65	0.91
Milk fat, %	4.30	4.16	0.13	0.43	0.95
Milk fat, kg/d	1.55	1.48	0.07	0.50	0.96
Milk protein, %	2.86	2.95	0.05	0.20	0.72
Milk protein, kg/d	1.03	1.06	0.03	0.45	0.81
Milk lactose, %	4.73	4.80	0.03	0.09	0.71
Milk lactose, kg/d	1.73	1.76	0.06	0.72	0.74
Milk urea N, mg/dl	13.2	12.7	0.7	0.64	0.91

[1]PEL=anionic salts supplied by commercially-formulated sulfur-based pellet;
IND=anionic salts supplied by a blend of individual anionic salts.
[2]3.5% fat-corrected milk; (0.4255*milk yield)+(16.425*milk fat yield).

Table 4. Effect of anionic salt source on blood mineral concentrations.

Item	Treatment[1] PEL	IND	SEM	*P*-value Treatment	Treatment*Time
Calcium, mg/dL	9.5	9.7	0.1	0.16	0.70
Phosphorus, mg/dL	5.1	5.1	0.1	0.98	0.77
Sodium, mmol/L	143.1	143.6	0.3	0.32	0.07
Potassium, mmol/L	4.3	4.4	0.1	0.82	0.57
Chloride, mmol/L	102.3	103.2	0.3	0.04	0.47
Magnesium, ppm	21.9	22.3	0.4	0.51	0.27

[1]PEL=anionic salts supplied by commercially-formulated sulfur-based pellet;
IND=anionic salts supplied by a blend of individual anionic salts.

Table 5. Effect of anionic salt source on blood metabolite concentrations.

Item	Treatment[1] PEL	IND	SEM	*P*-value Treatment	Treatment*Time
Prepartum (-21 d to calving)					
NEFA, µEq/L	178	153	16	0.26	<0.01
Glucose, mg/dL	66.2	67.6	0.8	0.22	0.84
Cholesterol, mg/dL	60.8	64.8	1.5	0.07	<0.01
BHBA, µmol/L	503	462	17	0.09	0.01
Postpartum (calving to d 56)					
NEFA, µEq/L	377	376	31	0.97	0.46
Glucose, mg/dL	57.8	58.3	0.8	0.71	0.53
Cholesterol, mg/dL	98.4	99.2	2.7	0.83	0.87
BHBA, µmol/L	730	738	64	0.93	0.53

[1]PEL=anionic salts supplied by commercially-formulated sulfur-based pellet;
IND=anionic salts supplied by a blend of individual anionic salts.

Table 6. Effect of anionic salt source on frequency of health disorders.

Item	Treatment[1] PEL	IND
Milk fever	0	0
Ketosis	3	6
Displaced abomasum	1	4
Retained placenta	2	1
Metritis	1	2
Twinning	1	2
Hoof disorders	6	1
Mastitis	4	3

[1]PEL=anionic salts supplied by commercially-formulated sulfur-based pellet;

RESULTS

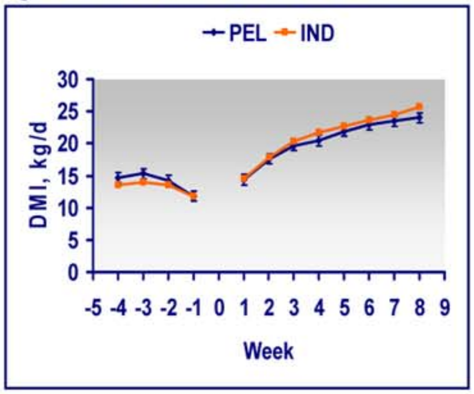

Figure 1. Effect of anionic salt source on DMI.

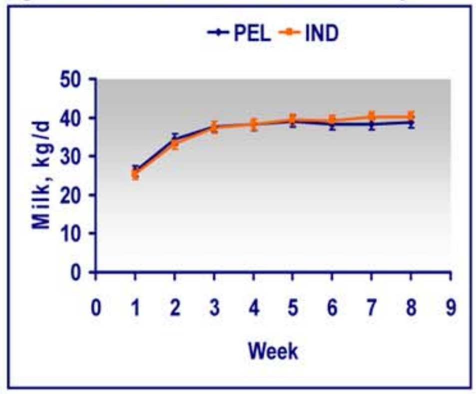

Figure 2. Effect of anionic salt source on milk yield.

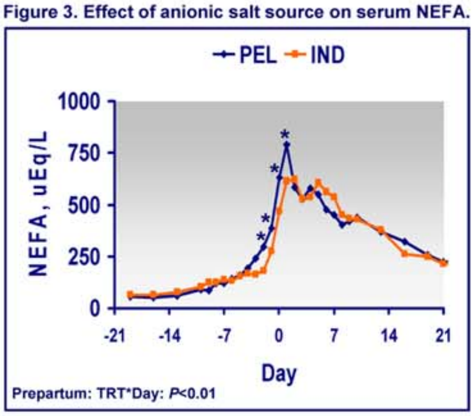

Figure 3. Effect of anionic salt source on serum NEFA.

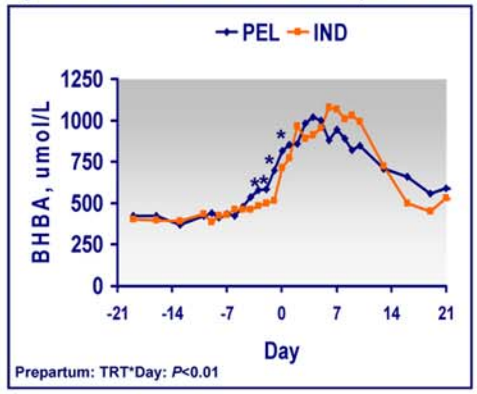

Figure 4. Effect of anionic salt source on plasma BHBA.

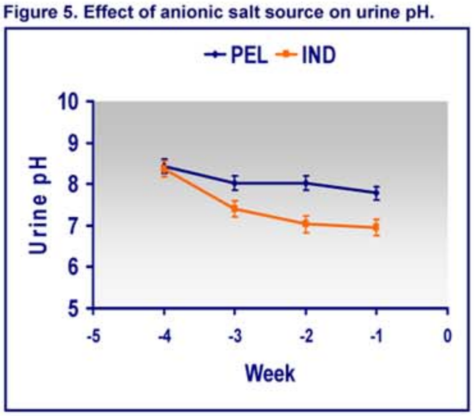

Figure 5. Effect of anionic salt source on urine pH.

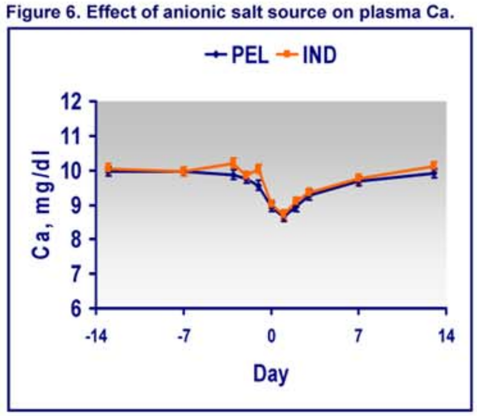

Figure 6. Effect of anionic salt source on plasma Ca.

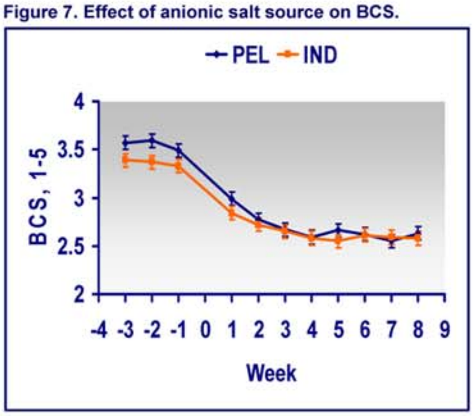

Figure 7. Effect of anionic salt source on BCS.

SUMMARY

- No differences in DMI or milk yield
- PEL was less effective at reducing urine pH
- Plasma Ca not different between PEL and IND
  - Both treatments maintained plasma Ca > 8.0 mg/dL
  - PEL maintained plasma Ca > 8.0 mg/dL though urine pH was not reduced
- PEL had greater prepartum NEFA and BHBA
  - Perhaps related to trend for higher prepartum BCS
- No differences in postpartum NEFA and BHBA
- A sulfur-based anionic salt pellet maintained plasma Ca, and perhaps urine pH sampling is not necessary when this product is fed