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Effects of chromium propionate fed through the periparturient period and starch source fed postpartum on productive performance and dry matter intake of Holstein cows[1]

Summary

Forty eight (48) Holstein cows entering second or greater lactation were used to determine milk production, dry matter intake (DMI), and metabolic responses to chromium propionate supplementation throughout the periparturient period and starch source in the post-partum diet. Treatments were chromium propionate (KemTRACE® brand Chromium Propionate, Kemin Industries, CrProp, 8 mg Cr/cow/d) or control (Con, no chromium propionate) from 28 d before expected parturition until 28 d post-partum, and dry corn (DC) or high moisture corn (HMC) in diets fed from parturition until 28 d post-partum. Cows were fed a common diet from 28 to 84 days post-partum. Milk production and dry matter intake were evaluated from parturition to 84 days in milk (DIM).

There was no effect of treatment on dry matter intake (DMI) in the post-partum period. However, chromium propionate interacted with starch source over time to positively affect DMI after treatment ceased and when cows were offered a common diet from weeks 4 to 12 post-partum. Additionally, chromium propionate tended to increase milk yield (122 vs. 114lb/d), FCM yield (115 vs. 106 lb/d), ECM Yield (114 vs. 106 lb/d) and cumulative milk yield (6,911 vs. 6,494 lb) from 28 to 84 DIM. Supplementation of chromium propionate throughout the periparturient positively affected production responses that were sustained after treatment application ceased.

Objectives

The objectives of this experiment were to determine the effects of KemTRACE® brand Chromium Propionate supplementation through the transition period on feed intake, metabolic parameters and production responses on cows fed two sources of corn.

Materials and Methods

Forty-eight (48) multiparous Holstein cows were randomly assigned to 1 of 4 treatments in a randomized block design with a 2x2 factorial arrangement of treatments with 12 cows per treatment.

Treatments

1. Chromium supplementation from -28 to 28 DIM with a HMC diet from calving to 28 DIM (CrProp/HMC)
2. Chromium supplementation from -28 to 28 DIM with a DC diet from calving to 28 DIM (CrProp/DC)
3. No chromium supplementation with a HMC diet from calving to 28 DIM (Con/HMC)
4. No chromium supplementation with a DC diet from calving to 28 DIM (Con/DC)

Chromium was supplied by KemTRACE® brand Chromium Propionate (chromium propionate, 0.04% chromium, Kemin Animal Nutrition and Health, Des Moines, IA), which was formulated to deliver 8 mg of Cr/cow/day.

All treatment diets were fed from 28 days before calving through 28 DIM. From 28 to 84 DIM, cows were offered a common diet with a 50/50 blend of HMC and DC. All diets were formulated to meet or exceed predicted requirements for minerals and vitamins (NRC, 2001). Ingredient and nutrient composition of the four diets fed throughout the experiment are listed in Table 1.

Cows were milked twice daily, and daily milk yield was recorded until 84 DIM. Milk samples were collected at each milking on one day per week, from 0 to 28 DIM and then biweekly until 84 DIM. Blood samples were collected approximately three hours before feeding and six hours after feeding weekly from -28 to 28 days relative to parturition. Data was analyzed according to stage of lactation:

- Pre-partum (-28 d to calving)
- Post-partum (calving to 28 DIM)
- Peak (28 to 84 DIM)

ANOVA was conducted using the GLM procedure of SAS (Version 9.2, SAS Institute, 2008). Treatment effects were declared significant at $P < 0.05$ and tendencies for treatment effects at $P < 0.10$. Interactions were declared significant at $P < 0.10$ and tendencies or treatment effects at $P < 0.15$.

Table 1. Ingredients and nutrient composition of experimental diets (% of dietary DM).

Item	Pre-partum diet	Post-partum diet		Peak diet
Ingredient		**DC**	**HMC**	
DC [1,4,5]		23.3		7.1
HMC [2,4,5]			23.3	6.6
Corn Silage	43.6	25.0	25.0	32.3
Alfalfa Silage		19.2	19.2	8.9
Grass hay	24.3			5.2
Alfalfa hay		11.8	11.8	2.0
Whole cotton seeds				5.9
Soy hulls				8.9
Soybean meal	17.5	12.9	12.9	14.6
SoyChlor®	1.8			
Mineral & Vitamin Mix	12.8	7.8	7.8	8.1
Nutrient Composition				
DM	49.2	50.3	48.0	53.2
OM	92.6	92.6	92.6	93.2
Starch	14.2	26.4	26.5	27.9
NDF	38.5	31.4	31.1	32.4
% NDF from forage	90.7	87.1	88.6	63.1
CP	15.7	16.2	16.2	16.6
Ether extract	3.0	3.9	3.8	4.32
Cr^3, mg/kg of DM	1.44	0.68	0.67	0.37

[1]DC = dry ground corn; [2]HMC = high-moisture corn; [3]Cr = chromium

[4]mean particle size (µm): dry sieve (DC = 1397; HMC =3758); wet sieve (DC = 1450; HMC = 3945)

[5]starch digestibility: 7-h starch in vitro starch digestibility (DC = 29%; HMC = 67%)

Results

Pre-partum period (-28d to calving)

No effect of treatment was detected for cumulative DMI for the 14 days before parturition. No effect of treatment was detected for BW or BCS or for plasma metabolite concentrations either before or after feeding.

Post-partum period (calving to 28 DIM)

High moisture corn increased yields of milk (94 vs. 86 lb, P = 0.02) and lactose (4.6 vs. 4.2 lb/d, P = 0.05), and cumulative milk yield for the first 28 DIM (2631 vs. 2417 lb, P = 0.02) compared with DC. Yields of fat and protein were not affected by treatment. Cumulative DMI over 28 DIM and FCE were not affected by treatment. There were numerical tendencies in milk yield during the post-partum period among treatments. During the post-partum period, chromium propionate supplementation resulted in a significant interaction between the treatment and the control groups which led to a carryover effect in Milk Yield, FCM, ECM and Cumulative Milk that will be discussed in the next section.

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Carryover effects of treatment on milk production (28 to 84 DIM)

The carryover effect is the residual effect seen in productivity after chromium propionate supplementation ceased at 28 days in milk. During the carryover effect (28-84 DIM) dry matter intake was higher for CrProp/HMC, lower for Con/DC, and intermediate for CrProp/DC and Con/HMC.

Chromium propionate tended to increase milk yield (122 vs. 114 lb/d, P = 0.09, Figure 1) as well as cumulative milk yield (6,911 vs. 6,494 lb, P = 0.10, Figure 2) from 28-84 DIM. These differences represented approximately 8 lb of additional milk per cow per day. By the end of the study, the CrProp/HMC treatment tended to increase FCM and ECM by approximately 15 and 12 lb/cow/d, respectively, compared with Con/DC (P

Economics

With an additional 8 lb of milk, the additional income based on the chromium propionate supplementation results in a benefit of $1.32/h/day. The economic benefit was calculated using a milk price of $17.00/cwt.

Figure 1. Milk Yield, lb/d, 28-84 DIM

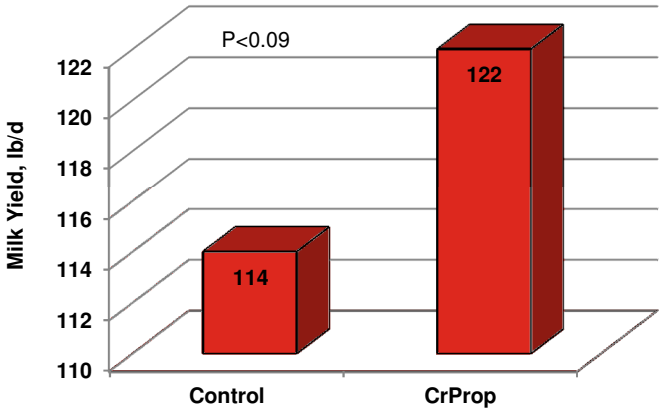

Figure 2. Cumulative Milk, lb, 28-84 DIM

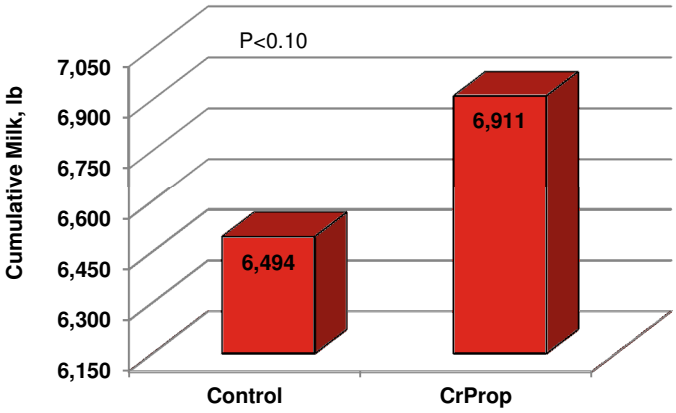

Figure 3. FCM, lb/d, Starch Source, 28-84 DIM

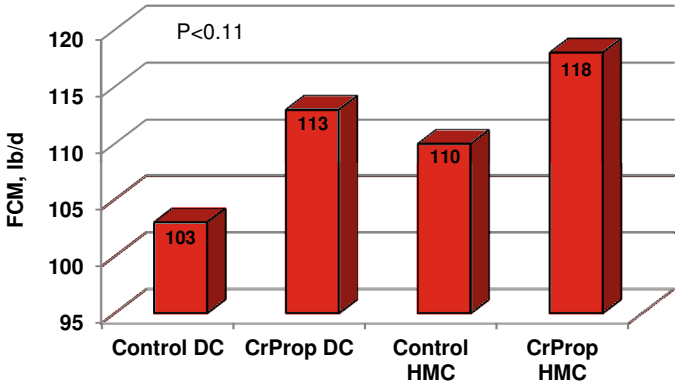

Figure 4. ECM, lb/d, Starch Source, 28-84 DIM

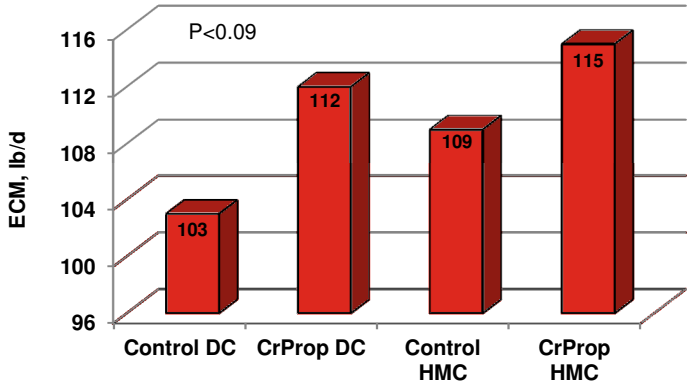

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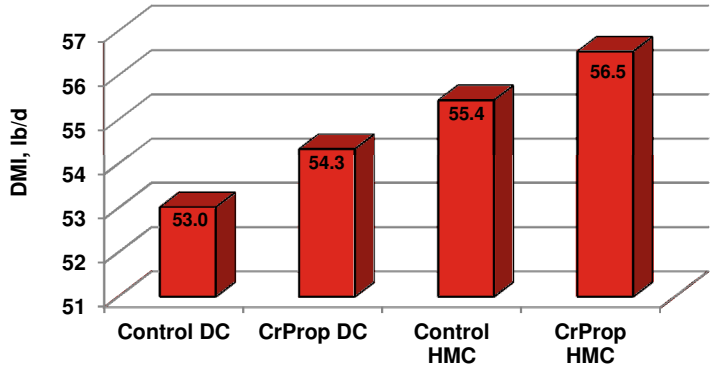
Figure 5. DMI, lb/d, Starch Source, 28-84 DIM



Conclusions

Although there were no effects of treatment on DMI in the post-partum period, chromium propionate interacted with starch source over time to positively affect DMI (Figure 5) after treatment ceased and when cows were offered a common diet from weeks 4 to 12 post-partum. A similar carryover effect was reported in a previous experiment in which chromium propionate supplementation increased DMI after treatment ceased at 35 d post-partum, with a numerical increase in milk yield (McNamara and Valdez, 2005). In the present experiment, chromium propionate tended to increase milk yield (122 vs. 114lb/d), FCM yield (115 vs. 106 lb/d), ECM yield (114 vs. 106 lb/d) and cumulative milk yield (6,911 vs. 6,494 lb) from 28 to 84 DIM.

Supplementation of chromium propionate throughout the periparturient positively affected production responses that were sustained after treatment application ceased. Differences among treatments for FCM yield were consistent with the differences among treatments for DMI. The effects of treatment on milk yield appeared to precede effects on DMI, which may be due to increased glucose supply to the mammary gland.

References

1. Effects of chromium propionate fed through the periparturient period and starch source fed postpartum on productive performance and dry matter intake of Holstein cows. R. J. Rockwell* and M. S. Allen, Michigan State University, East Lansing. Presented at the ADSA/ASAS meeting 2011. Published in the Journal of Dairy Science, 2011, vol. 94, E-supplement 1, pg. 738 (Abstract).
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4. M.S. Allen, R.J. Rockwell, R. Londuski, F. Valdez, Michigan State University, Lansing, MI. Effect of KemTRACE® brand Chromium Propionate fed through the transition period and its interaction with starch fermentability of diets fed post-partum on yield of milk and milk components, metabolism, and energy balance of dairy cows. SD-12-00003