Dietary Supplementation with Conjugated Linoleic Acid (CLA) on Production, Health and Culling Parameters in Transitioning Holstein Cows

A.S. Leaflet R2707

Nathan Upah, graduate research assistant; Pat Gorden, senior clinician; Lance Baumgard, associate professor, Department of Animal Science

Summary and Implications

Lactating Holstein cows were assigned to one of three dietary CLA treatments. Study objectives were to determine the effects of a protected (lipid-encapsulated *tran*-10, *cis*-12) CLA on milk production, health and culling frequency, reproduction and overall feasibility in large commercial dairy operations. Results indicate that CLA is capable of inducing milk fat depression (MFD) within 15 d following parturition and the reduced milk energy output likely indicates an improved energetic status. However, feeding CLA had no effect on other productions, metabolic, health, or culling variables.

Materials and Methods

All procedures were reviewed and approved by the Iowa State University Institutional Animal Care and Use Committee. Multiparous (n=299) and primiparous (n=180) Holstein cows were blocked by previous 305 mature equivalent milk yield and parity, then assigned to one of three dietary treatments which began 21 d prior to expected calving and ceased at 15 DIM ± 3 d: 1) no CLA supplementation, Con; 2) 50 g/h/d prepartum followed by 150 g/h/d through 15 DIM, CLA1 (Lutrell®, BASF, Germany) and 3) 50 g/h/d prepartum followed by 75 g/h/day through 15 DIM, CLA2 (Lutrell®, BASF, Germany). Cows were housed and managed at the Lake Breeze Dairy, Fon du Lac, WI. After 15 DIM ± 3 d, cows left the "fresh pen" and were co-mingled in the "high pen". Lake Breeze Dairy could not logistically handle three treatments simultaneously, so CLA2 feeding was initiated immediately following the conclusion of Con and CLA1 treatments in the pre-fresh pens. The trial was conducted from April 2010 until February 2011. Cows in the Con and CLA1 calved beginning April 29, 2010 and were completed by May 29, 2010; CLA2 began calving on June 17, 2010 and concluded July 2, 2010. All production parameters were recorded through 200 DIM. All cows were fed a diet that was iso-energetic and iso-nitrogenous via TMR formulated by Nutrition Professionals Inc. (Neenah, WI) to meet or exceed the predicted requirements (NRC, 2001) of energy, protein, minerals and vitamins. Corn silage was the main forage source and ground corn was the primary concentrate. The TMR was sampled weekly, composited monthly and analyzed via wet chemistry methods (AgSource Cooperative Service, Bonduel, WI). Fresh feed was offered daily at 0800 h.

Cows were milked thrice daily and milk yield was recorded and condensed into weekly means for statistical analysis. Milk composition samples were obtained weekly on all cows for three weeks post freshening with subsequent monthly composition sampling up to 200 DIM. Sampling and milk composition analysis was conducted by AgSource Cooperative Services (Bonduel, WI). Milk sampling occurred based upon calendar dates, milk composition samples were assigned a theoretical DIM dependent upon the cow's actual DIM. For example, cows 1-8 DIM were assigned to time point 8 DIM; cows 9-16 DIM were assigned to time point 16 and so forth for the each milk composition sample.

All health, culling and reproductive parameters were recorded by Lake Breeze Dairy staff. Observations and general health events were recorded throughout the study. Cows were removed from statistical analysis if their gestational length was less than 260 d, had multiple births, or if cows were moved to an incorrect pen following freshening.

Milk yield was analyzed by repeated measures using the PROC MIXED procedure of SAS (2005) with an autoregressive covariance structure and week of lactation or DIM serving as the repeated effect. The model contained week of lactation, treatment, parity, week of lactation x treatment interactions and parity x week of lactation x treatment interactions. Cows were the random effect and week of lactation, treatment, parity, week of lactation x treatment interaction and parity x week of lactation x treatment interactions were the fixed effects. Milk components were analyzed by repeated measures using the MIXED procedure of SAS (2005) with an autoregressive covariance structure and day of lactation as the repeated effect. Health frequency and culling events were analyzed by using the ANOVA procedure of SAS (2005). The model contained treatment interactions. Standard errors of the mean are reported and differences considered significant when $P<0.05$ unless otherwise stated.

Results and Discussion

Overall milk fat content was significantly decreased ($P<0.05$) by CLA supplementation with MFD becoming significant for both CLA treatments at 8 DIM (5.3%). The CLA induced-MFD continued to become more severe at 15 DIM (8.5%) and MFD reached its plateau (~11.6%) at 30

DIM (despite CLA supplementation ceasing at 15 DIM). The extent of MFD for CLA1 and CLA2 did not differ.

There were little or no effect on milk yield or milk composition from cows fed either CLA treatment. In addition, the improved energetic status in the CLA fed cows did not improve reproductive parameters (data not shown) nor reduce the incidence of health disorders. In particular, we hypothesized the improved energy status would reduce the need to mobilize adipose tissue and reduce the occurrence of ketosis but this parameter was not affected by treatment.

Typically, CLA induces MFD in a dose dependent manner, so reasons why milk fat was reduced similarly between the two CLA treatments is not-known. In addition, reasons why we did not observe an increase in milk yield, which has been frequently reported in the literature, remains unknown as well. We hypothesize that the magnitude of MFD probably needs to be more severe (i.e. >15%) in order for the energy savings from the synthesis of milk fat to be partitioned to the synthesis of overall milk yield. Future studies are required in order to determine the optimum CLA dose necessary to improve transition success in the periparturient cow.

Acknowledgments

We gratefully acknowledge the contributions of the staff at the Lake Breeze Dairy Farm and financial contributions from BASF.

Table 1. Effect of CLA on milk production parameters.[1]

	Treatment				*P*					
Parameter	Con	CLA1	CLA2	SEM	TRT	PAR	TRT x WOL	WOL x PAR	TRT x WOL x PAR	Contrast
Milk Yield, kg/d	39.54	39.86	39.63	0.42	0.86	<0.01	<0.01	<0.01	0.82	0.61
Milk Composition										
Fat, %	3.48[a]	3.37[b]	3.36[b]	0.04	0.05	<0.01	<0.01	<0.01	0.77	0.01
Protein, %	3.02	2.98	3.00	0.02	0.72	<0.01	<0.01	<0.01	0.12	0.43
Lactose, %	4.84	4.84	4.84	0.02	0.97	<0.01	<0.01	<0.01	0.25	0.83
SNF[2], %	8.76	8.76	8.74	0.15	0.91	0.88	<0.01	<0.01	<0.01	0.65
SCC[3], x 10^5	1.79	1.75	1.84	0.03	0.12	0.09	0.58	<0.01	0.99	0.67

[1]Average over the 200 d post-partum period
[2] Solids-nonfat
[3]Somatic Cell Count
[a,b] Values within rows with differing superscripts indicate $P < 0.05$

Table 2. Effect of CLA on health and culling events.

	Treatment				*P*
Health Event	Control	CLA1	CLA2	SEM	Trt
DA[1], % (#)	3 (2)	4 (4)	2(1)	1.4	0.54
Ketosis, % (#)	20 (16)	16 (16)	20 (16)	3.5	0.99
Lameness, % (#)	19 (15)	20 (20)	20 (16)	4.7	0.79
Mastitis, % (#)	46 (38)	33 (33)	54 (43)	6.7	0.52
Metritis, % (#)	9 (7)	9 (9)	17 (13)	2.8	0.23
Retained Placenta, % (#)	6 (4)	6 (6)	12 (9)	2.3	0.30
Culling Event					
Total Culls, %	12.7	17.0	16.3	2.0	0.55
Low Production, %	5.2	4.0	12.5	5.0	0.49
Reproductive, %	0.0	0.0	8.0	3.0	0.15
Injury or Other, %	63.0	56.0	50.0	6.0	0.69
Mastitis, %	26.3	28.0	16.6	9.0	0.62
Lameness, %	5.2	12.0	12.5	6.0	0.70

[1]Displaced Abomasum