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Effects of Dietary Fat Source on Performance of Lactating Dairy Cows Fed a Pre-mixed Concentrate

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Abstract

Inclusion of a pre-blended concentrate (OneTrak®, Cargill Inc., Blair, NE) in the total mixed ration (TMR) for dairy cows can simplify the daily mixing of dietary ingredients. A cow's response to fat supplementation can be affected by other dietary ingredients; however, little is known about production responses to dietary fat in diets with high concentrations of non-forage fiber. This study evaluated cow performance in response to fat sources when the ration contained a pre-blended concentrate composed largely of a non-forage fiber source. Six pens of mid-lactation cows were studied; the addition of saturated fat (Energy Booster 100) and rumen-protected unsaturated fat (Megalac) were compared to a control diet with no added fat. Milk yield tended to increase with both fat sources. Protein concentration decreased with fat supplementation but protein yield did not differ. Efficiency of conversion of feed to milk tended to increase for Megalac compared with Energy Booster. These responses to dietary fat are comparable to those for diets without OneTrak®, suggesting that no unusual dietary interactions with fat supplements are apparent with OneTrak® feeding programs.

Keywords

fat, lactation, nutrition

Authors

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Summary
Inclusion of a pre-blended concentrate (OneTrak®, Cargill Inc., Blair, NE) in the total mixed ration (TMR) for dairy cows can simplify the daily mixing of dietary ingredients. A cow's response to fat supplementation can be affected by other dietary ingredients; however, little is known about production responses to dietary fat in diets with high concentrations of non-forage fiber. This study evaluated cow performance in response to fat sources when the ration contained a pre-blended concentrate composed largely of a non-forage fiber source. Six pens of mid-lactation cows were studied; the addition of saturated fat (Energy Booster 100) and rumen-protected unsaturated fat (Megalac) were compared to a control diet with no added fat. Milk yield tended to increase with both fat sources. Protein concentration decreased with fat supplementation but protein yield did not differ. Efficiency of conversion of feed to milk tended to increase for Megalac compared with Energy Booster. These responses to dietary fat are comparable to those for diets without OneTrak®, suggesting that no unusual dietary interactions with fat supplements are apparent with OneTrak® feeding programs.

Key words: fat, lactation, nutrition

Introduction
Fat supplementation is common in lactating dairy cattle diets, as it has potential to positively affect milk production. Response to added fat can vary between fat sources, depending on the degree of saturation, digestibility, and the effect of fat on rumen microbial populations. A variety of fat sources are commercially available; saturated fats, as well as different forms of protected unsaturated fats, have minimal toxic effects on rumen microbes and fiber digestibility, and can be incorporated in lactation diets at up to 3-4% of diet dry matter. However, production responses to fat supplementation can be affected by other dietary ingredients.

A pre-mixed concentrate that includes all protein concentrates, vitamins, and minerals can greatly reduce the labor and potential error involved in daily preparation of dairy cattle rations. Furthermore, a modified wet pre-mixed concentrate with a substantial fiber fraction can be fed as a large proportion of the diet and may help to minimize on-farm shrink (loss of feed). The objective of this study was to determine whether the addition of saturated or unsaturated fat sources increases milk production efficiency of lactating Holstein cows fed a diet containing OneTrak®, a premixed concentrate.

Experimental Procedures

The study was conducted from January to March of 2015 at the Kansas State University Dairy Teaching and Research Center. Seventy-two Holstein cows (166 ± 25 days in milk, parity 1.7 ± 0.9, mean ± SD) were blocked by parity, stratified by days in milk (DIM), and randomly assigned to 6 pens within strata. Each pen contained 6 primiparous and 6 multiparous cows, and mean days in milk and milk yield were similar across pens. Diets were formulated to contain 44% OneTrak® on a dry matter (DM) basis; forages were alfalfa hay and corn silage (Table 1).

Pens were randomly assigned to treatment sequence in a 3 × 3 Latin square design. Treatments consisted of no added dietary fat, Megalac (Church and Dwight Co. Inc., Princeton, NJ), or Energy Booster 100 (Milk Specialties Co., Dundee, IL); fat sources were included to provide 1.2% added fat (% of diet DM). Each treatment period was 21 days, allowing for dietary adaptation before samples were collected.

Milk weights were recorded and milk samples were collected for component analysis during each milking for the final four days of each period. Feed intake was recorded during day 17 through 20 of each period. Samples of TMR and dietary ingredients were also collected during day 17 through 20 of each period and composited for nutrient analysis (Dairy One Forage Laboratory, Ithaca, NY; Table 2). Initial and final body weights (BW) were recorded for each period. Body condition score (BCS) was assessed at the beginning and end of each period by 3 trained individuals and averaged per time point. One cow was removed from the study after period 1 due to mastitis, and was replaced for periods 2 and 3. Two cows were removed due to unrelated illness during period 3.

Statistical analysis was performed using SAS (version 9.3, SAS Inst., Inc., Cary, NC). Milk production parameters were analyzed with treatment as a fixed effect and pen, period, cow within pen, and pen × treatment as random effects. Pen-level feed intake was divided by the number of cows in the pen and analyzed with treatment as a fixed effect and pen and period as random effects. Treatment means were evaluated using the following contrasts: 1) effect of fat supplementation (no added fat vs. Megalac and Energy Booster) and 2) effect of fat source (Megalac vs. Energy Booster). Significance was declared at $P < 0.05$ and tendencies were declared at $0.05 \leq P < 0.10$.

Results

Production responses to fat supplementation are summarized in Table 3. Fat supplementation tended to increase milk yield compared with no added dietary fat, but there was no difference between fat sources. Milk protein concentration decreased with the addition of fat, to a greater extent for Megalac than for Energy Booster; however, milk protein yield was unaffected by treatment. Milk urea nitrogen decreased with fat supplementation, regardless of fat source. Fat corrected milk yield tended to increase with added dietary fat but was unaffected by fat source. Dry matter intake tended to increase with fat supplementation, with no difference caused by fat source. Conversion of feed to milk tended to increase for cows supplemented with Megalac, but treatment had no effect on efficiency of fat corrected or energy corrected milk production. No differences were detected for milk fat concentration, lactose, somatic cell linear score, energy corrected milk, body weight, or body condition score.

Discussion

Inclusion of OneTrak® in the total mixed ration for dairy cows can benefit the producer by simplifying the daily mixing of dietary ingredients. Decreasing the number of different ingredients to be mixed can save time as well as decrease waste due to inaccurate measuring or loss of micro-ingredients during the mixing process. Cow response to fat supplementation can vary; in this case supplementation tended to increase milk yield, which could have been driven by the tendency for increased feed intake. Fat supplementation can often increase milk yield through increased energy density of the diet, but in this case energy density was similar between diets. Fat supplementation decreased milk urea nitrogen, indicating possible differences in efficiency of microbial protein synthesis. Milk protein concentration was lower for both fat sources, but due to increased milk yield, overall protein yield did not differ.

Cows in this study were, on average, in relatively late lactation and were below average milk yield for the herd. Some studies have shown larger responses to dietary fat inclusion for higher-yielding early lactation cows. Nevertheless, it is also true that the milk yield response to dietary fat in this study was similar to the mean response reported in the literature, and producers feeding similar diets can use these responses for cost/benefit analysis with confidence.

Conclusions

Fat supplementation of diets containing OneTrak® yielded results similar to those reported in more traditional lactation diets. Both fat sources tended to slightly increase milk yield as well as decrease protein %, and feed efficiency tended to increase for Megalac compared with Energy Booster. Results may vary with differing ratios of alfalfa to corn silage in the ration, as well as with cows in earlier stages of lactation than were used in this study. For the diets evaluated in this study, dietary fat was marginally effective at increasing productivity.

Table 1. Diet composition (% of DM)

Ingredient	No added fat	Megalac	Energy Booster
OneTrak®	44.1	44.1	44.1
Corn grain	10.8	10.8	10.8
Corn silage	35.8	35.8	35.8
Alfalfa hay	7.8	7.8	7.8
Soybean hulls	1.5	--	0.2
Megalac	--	1.47	--
Energy Booster	--	--	1.27
Rumensin 90	0.006	0.006	0.006

Table 2. Nutrient composition of total mixed rations

	No added fat		Megalac		Energy Booster	
Nutrient, % of DM	Mean*	SD	Mean	SD	Mean	SD
Dry matter, % as-fed	46.83	2.05	47.13	1.88	46.73	0.55
Crude protein	17.80	0.20	17.63	0.51	17.33	0.40
Soluble protein, % CP	40.00	2.65	39.00	1.00	38.33	2.52
Acid detergent fiber	20.17	0.93	18.53	1.68	19.43	0.80
Neutral detergent fiber	32.53	1.86	31.30	3.12	35.77	1.59
Lignin	3.63	0.57	3.83	0.15	3.93	0.25
Ash	7.70	0.29	8.08	0.37	8.09	0.18
Crude fat	2.77	0.15	4.07	0.12	3.73	0.21
Non-fiber carbohydrate	39.27	1.56	38.93	3.30	35.10	1.21
Starch	19.77	0.25	19.23	1.87	18.57	1.21
NE_L, Mcal/lb	0.73	0.01	0.75	0.02	0.73	0.01

*Means and standard deviations of values from three sampling periods.

Table 3. Effect of supplemental fat on milk production parameters

	Diet				*P*-value	
Item	No added fat	Megalac	Energy Booster	SEM	Added fat	Source
Milk yield, lb/day	73.9	75.6	75.4	2.9	0.06	0.64
Fat %	3.95	3.92	3.92	0.10	0.57	0.92
Fat yield, lb/day	2.89	2.95	2.93	0.13	0.19	0.86
Protein %	3.43	3.31	3.37	0.052	0.001	0.02
Protein yield, lb/day	2.51	2.49	2.51	0.08	0.59	0.24
Lactose %	4.81	4.80	4.80	0.048	0.79	0.92
Lactose yield, lb/day	3.57	3.64	3.64	0.16	0.12	0.87
Milk urea nitrogen, mg/dL	13.98	13.55	13.48	0.57	0.04	0.75
SCLS*	1.99	1.95	2.00	0.19	0.92	0.69
Energy-corrected milk, lb/d	80.5	81.8	81.8	3.1	0.18	0.99
3.5% fat-corrected milk, lb/day	78.7	80.5	80.3	3.1	0.09	0.75
Dry matter intake, lb/d	53.4	54.0	54.5	0.7	0.07	0.48
Milk:DMI	1.39	1.41	1.38	0.049	0.70	0.06
ECM:DMI	1.53	1.54	1.51	0.052	0.68	0.18
FCM:DMI	1.49	1.51	1.48	0.051	0.87	0.13
Initial BCS	3.45	3.44	3.47	0.12	0.99	0.46
Final BCS	3.57	3.56	3.58	0.074	0.98	0.56
BCS change/21 days	0.12	0.12	0.12	0.070	0.95	0.94
Initial BW, lb	1539	1552	1521	42	0.94	0.31
Final BW, lb	1588	1555	1574	54	0.36	0.49
BW change, lb/21 days	47	1	54	86	0.37	0.49

*SCLS = somatic cell linear score; calculated by log2(SCC/100)+3.