Does Prebreeding Fat or Protein Supplementation Improve Rebreeding Performance?

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The objective of this investigation was to determine the value of prebreeding protein or protein-sunflower oil supplementation on reproductive performance in post-partum beef cows. Thirty-six day supplementation prior to the onset of artificial insemination effectively reduced the amount of hay fed, but did not improve timed first-service conception rate, 21 day pregnancy rate, or overall pregnancy rate.

Summary

Two hundred forty-eight mixed age postpartum beef cows (3 - 10 yr. of age) were used to evaluate the effect of added protein or protein plus 10% fat from sunflower oil (Protein + SFO), when fed 36 days prebreeding, on cow condition change, reproductive performance, and calf growth.

Sunflower oil supplementation did not improve first-service timed AI pregnancy rate; however, based on ultrasound cranial width, protein + SFO tended to improve 21 d natural service pregnancy rate compared to control and protein supplemented groups (P = 0.08). When timed AI and 21 d natural service pregnancy rates were combined, the effect due to treatment did not differ (P = 0.36). Overall pregnancy rate for the 42 d breeding season was numerically greater for the protein + SFO treatment, however, the observed increase did not differ from the other treatments (P = 0.19), and the number of open cows 48 d after the end of the breeding season was similar (P = 0.33).

During the prebreeding supplementation period, cow weight and BCS tended to decline across all treatments, but did not differ (P = 0.19).

Economic impact of the protein and protein + SFO treatments were calculated as the value of calves and cull cows assumed sold under each treatment less associated feed costs during the 36 d pre-breeding period. Individual year pregnancy rate and timing data were used to calculate revenues using a 100-cow reference herd. Since revenues did not differ substantially between treatments, and supplement cost increased expenses in within treatment groups, supplementation decreased economic return.

Introduction

Feeding fat to beef cows after calving as a source of supplemental energy is not a new practice. Fat is a concentrated energy source, containing 2.25 times more energy per unit weight than either carbohydrates or protein. Research indicates added dietary fat of plant origin can positively influence reproductive response independent of caloric effects. Positive ovarian physiological responses include increased follicular growth and function, increased corpus luteum (CL) lifespan, and shortened postpartum interval (Talavera et al., 1991; Thomas et al., 1997; Williams and Stanko, 1999). In a review of fat feeding experiments utilizing safflower, Hess (2003) concluded the addition of supplemental fat may increase the percentage of cows exhibiting ovarian luteal activity, but the interval from calving to the first ovulatory estrus, first service conception rate and overall conception rate were not improved. Landblom et al. (2002) evaluated protein supplementation with fat enhancement from either beef tallow or soybean oil when fed from 30 days before calving to 30 days after the last cow calved. Feeding either tallow or soybean oil pre- and postcalving did not improve reproductive performance.

The present investigation was designed to evaluate the value of sunflower oil as a partial replacement for hay that may improve reproductive performance in postpartum beef cows independent of caloric effects.

Procedure

Two hundred forty-eight beef cows (3 to 10 yr. of age) were used in a complete randomized design in which pen served as the experimental unit with four pen replicates per treatment. The experimental treatments were fed an average of 36 d prebreeding. After calving and prior to the initiation of the prebreeding supplementation, all cows were fed medium-quality alfalfa-grass mixed hay (Dry Matter Basis: 96.26% DM; 10.81% Ash; 10.75% CP; 39.7% ADF; 58.61% NDF; 61.44% IVDMD and 56.42% IVOMD). Cows were assigned to either control (n =

83), protein (n = 81), or protein + sunflower oil (n = 84) treatments (Table 1). In year 1, supplements and hay provided 676 and 594 grams of metabolizable protein per day in excess of NRC (1996) requirements and 0.31 and 0.29 Mcal/lb. of net energy for gain for the protein and protein + fat treatment groups, respectively. However, in year 2, the amount of supplement offered to the cows was adjusted between the two supplement treatments to more closely balance metabolizable protein per day and net energy for gain. The adjustments were made such that supplement and hay provided 654 and 617grams of metabolizable protein per day in excess of NRC (1996) requirements and 0.30 and 0.30 Mcal/lb. of net energy for gain was provided for the protein and protein + fat treatment groups, respectively (Table 2).

The first year of the investigation, control cows received 46.77 lbs. of medium-quality alfalfa hay/head/day and supplemented cows received an average 41.62 lbs. of the same medium-quality alfalfa hay/head/day plus either 6.84 pounds of the 18% crude protein supplement or 5.02 pounds of the 18% crude protein supplement with 10% added fat. In year 2, control cows received 46.1 lbs. medium-quality alfalfa hay/head/day and supplemented cows received an average 42.0 lbs. of a medium-quality alfalfa hay/head/day plus either 6.45 lbs of the 18% crude protein supplement or 5.45 lbs of the 18% crude protein supplement with 10% added fat (Table 2). The supplements were fed such that the respective diets were isocaloric but not isonitrogenous and were fed in concrete bunks on alternate days.

Supplement feeding began an average 36 d prior to the start of a GnRH/PG synchronized timed artificial insemination (AI) breeding season and ended when breeding began. Ninety d after the start of the AI breeding season all cows were scanned using rectal ultrasound to determine pregnancy and fetal age based on cranial width. Effect of supplementation on reproductive performance was measured for first service timed AI pregnancy rate, 21 d natural service, 42 d pregnancy rate, overall pregnancy rate, and the percent of open cows. Calf performance was monitored during the prebreeding supplementation period.

Economic impact of the protein and protein + SFO supplements were calculated based on local and regional market value of calves and cull cows sold under each treatment less associated feed costs during the 36 d pre-breeding period. Individual year pregnancy rate and timing data were used to calculate revenues. A 100-cow herd was used for reference.

Cow weight change, body condition score, ultrasound fat depth, and growth data were analyzed as a complete randomized design with the GLM procedure of SAS (SAS Inst. Inc., Cary, NC, 2003) using pen as the experimental unit. The model included treatment and year and the two-way interaction between treatment and year. When an interaction was not significant, the data was combined and re-analyzed. Differences were not considered significant when (P > 0.05). Breeding cycle pregnancy frequency data was analyzed using Chi Square analysis procedures of SAS (SAS Inst. Inc., Cary, NC, 2003).

Results

The effect of supplemental protein or protein + SFO on cow and calf performance prebreeding and reproductive performance was evaluated based on changes in body weight and condition score, rib fat depth change, first service and subsequent heat cycle pregnancy rates, and calf growth.

During the average 36 d period preceding the start of the breeding season, cow body weight declined in all treatment groups, but did not differ (P = 0.26) (Table 3).

The primary aspect of this investigation was to not only determine whether fat supplementation from sunflower oil could replace a portion of the hay fed, but also to determine the value of prebreeding fat supplementation on first service timed AI, 21 d natural service, and overall pregnancy rates. While we did not document luteal tissue change, Talavera et al. (1991), Thomas et al. (1997), and Williams and Stanko (1999) and others have investigated the effect of dietary lipids on follicular growth and concluded that supplemental lipids could positively influence follicular development and potentially first service pregnancy rate. The impact of lipids on follicular development was reported to occur independently of caloric affects and was often associated with fat supplementation.

Breeding cycle pregnancy rates are shown in Table 4. Compared to the unsupplemented control cows, first service timed AI pregnancy rate among supplemented cows did not differ (P = 0.32). One of the many economically significant advantages for synchronization is that two estrous cycles can be attained within the initial 21-25 d period. In the study, a tendency was observed for a supplementation treatment effect for 21 d pregnancy rate (P = 0.08). Protein supplementation improved pregnancy rate year 1 and protein + SFO improved pregnancy rate year 2. Overall, when first service timed AI and 21 d natural service pregnancy were combined, the effect due to treatment did not differ (*P* = 0.36). For the 42 d pregnancy rate, a significant year effect (*P* = 0.001) was observed, but effects due to treatment did not differ (*P* = 0.57). Overall pregnancy rates between treatments (*P* = 0.19) and between years (*P* = 0.68) did not differ. While the percentage of open cows was consistently lower for cows receiving the protein + SFO treatment, the results did not differ (*P* = 0.33).

Body condition is recognized as being highly correlated with successful reproductive function in beef cattle. Change in body condition was scored using a visual body condition score (1-emaciated to 9 - obese) and ultrasound rib fat depth. Body condition score among all cows declined during the prebreeding period, but did not differ between treatments (*P* = 0.19). For rib fat change during the prebreeding supplementation period, no year (*P* = 0.50) or treatment (*P* = 0.20) effects were measured; however there was trend toward a year x treatment (*P* = 0.08) interactions.

Calf growth during the supplementation period was monitored, but no treatment effect for calf growth was identified; gain (*P* = 0.32) and ADG (*P* = 0.34) did not differ.

There was little difference in revenue by treatment in either year, or when the two years were combined (Table 5). There was less income generated from cull cows for the protein + SFO treatment in both years which reflects greater overall pregnancy rates among the herd. The protein + SFO treatment resulted in greater income from the sale of calves overall for the same reason. However, income from the sale of calves was slightly greater for the control diet in 2003 because calves were, on average, sold at a heavier weight. The effect of pregnancy rates and associated culling activity on revenues will vary with relative prices for cull cows and calves. Because revenues did not differ greatly; and there was additional expense associated with supplementation, feeding protein or protein + SFO supplements decreased economic return.

Implication

Providing prebreeding protein or protein plus 10% sunflower oil in daily fed supplements adequately replaced a portion of the hay that was fed, which would be desirable for drought management, but did not improve timed first service pregnancy rate, combined first service and 21 d pregnancy rate or overall pregnancy rate when offered to cows consuming diets based on medium-quality alfalfa grass hay. Additionally, when cows are on an adequate plane of nutrition after calving, and are in pre-breeding body condition score of '5', or greater, supplementation cost may negatively impact economic return.

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Table 1. Experimental prebreeding supplement ingredient composition (As Fed).

Ingredients	Protein	Protein + SF Oil
Wheat Midds, %	30.02	25.97
Barley Malt Sprouts %	30.00	20.00
Cull Beans, %	20.00	20.00
Sunflower Oil, %	0.00	10.00
Canola Meal, %	5.00	10.00
Distillers Dried Grain, %	3.75	5.00
Other[a,b,c]	11.23	9.03
Crude Protein, %	18.20	18.11
UIP, %	5.45	5.28
Crude Fat, %	2.64	12.56
ADF, %	9.83	9.18
NDF,%	26.75	23.37
Calcium, %	1.20	0.79
Phosphorus, %	0.84	0.56

[a] Trace Mineral Pack provided: manganese 130ppm, iron 108ppm, copper 68.95ppm, zinc 238ppm, Cobalt 1.13ppm, iodine 5.42ppm, sulfur .22%

[b] Vitamin Pack provided: vit A 16.0 KIU/lb.,vit D-3 1.60 KIU/lb., vit E 16.0 IU/lb., thiamine 2.71 mg/lb.

[c]Molasses 5%; Bentonite 2%; Salt 1.75, 1.35%; Dical Phos (21%) 1.85, 1.30%; Molastik Binder 0.20%; Selenium-1600 0.063%.

Table 2. Prebreeding hay and supplement fed (As Fed).

	Control	Protein		Protein + SF Oil	
No. Cows	43	44		42	
Amount/Cow/Day:					
Yr. 1:					
Alfalfa/Cow/Day, lbs.	46.77	41.69		41.55	
Suppl./Cow/Day, lbs.		6.84		5.02	
Yr. 2:					
Alfalfa/Cow/Day, lbs.	46.10	41.80		42.10	
Suppl./Cow/Day, lbs.		6.45		5.45	
Formulated MP[a] and Energy Balance		**Year 1**	**Year 2**	**Year 1**	**Year 2**
Metabolizable Protein					
Diet, g/d		1565	1543	1483	1506
Requirement, g/d		889	889	889	889
Excess of Requirement, g/d		676	654	594	617
NE_g, Mcal/lb.		0.31	0.30	0.29	0.30

[a]Metabolizable Protein

Table 3. Postcalving cow weight change following prebreeding supplementation.

	Control	Protein	Protein + SF Oil	SE	P-Value
Days on Test	36	36	36		
Average Cows Age, yrs.	5.0	4.8	4.7		
Postcalving Cow Wt., lbs.	1239	1240	1232	36.2	.98
Breeding Wt., lbs.	1196	1207	1217	32.3	.90
Cow Wt. Change, lbs.	-43	-33	-15	6.9	.26

Table 4. Prebreeding supplementation effect on breeding cycle pregnancy rates.

		Control	Protein	Protein + SF Oil	P-Value[b]	
					Year	Treatment
Pregnancy Rate:[a]						
AI, %	Yr 1	44.2	21.4	31.8	0.39	0.32
	Yr 2	37.5	48.7	27.5		
21d, %	Yr 1	34.9	64.3	56.8	0.47	0.077
	Yr 2	57.5[b]	41.0[c]	70.0[a]		
Combined 21d	Yr 1	79.1	85.7	88.6	0.01	0.36
	Yr 2	95.0	89.7	97.5		
42d, %	Yr 1	11.6	7.4	9.3	0.001	0.57
	Yr 2	2.5	0.0	0.0		
Overall Preg. Rate	Yr 1	90.7	93.1	97.9	0.68	0.19
	Yr 2	97.5	89.7	97.5		
Open, %	Yr 1	9.3	6.9	2.1	<0.01	0.33
	Yr 2	2.5	10.3	2.5		

[a] Ultrasound cranial measurements and regression analysis were used to compute fetal age following measurement taken 90 days after timed insemination. Means with unlike superscripts differ significantly ($P < 0.10$).
[b]Chi Square analysis.

Table 5. Economic impact; 100 cow case herd (Dollars).

	2002			2003			Average		
	Control	Protein	Protein + SF Oil	Control	Protein	Protein + SF Oil	Control	Protein	Protein + SF Oil
Revenue, $									
Cull cows	3,971	2,946	897	1,421	5,855	1,421	2,696	4,400	1,159
Calves									
708 lb	29,528	14,297	21,244	28,274	36,718	20,734	28,901	25,507	20,989
650 lb	22,073	40,668	35,925	40,370	28,786	49,146	31,222	34,727	42,535
592 lb	6,877	4,387	5,513	1,662	0	0	4,269	2,193	2,757
Total calves	58,478	59,352	62,682	70,305	65,504	69,880	64,392	62,428	66,281
Total revenue, $	62,449	62,298	63,579	71,726	71,359	71,301	67,088	66,828	67,440
Revenue / cow, $	624	623	636	717	714	713	671	668	674
Expenses, $									
Cow feed, 36 d	3,788	5,347	4,811	3,734	5,243	5,006	3,761	5,295	4,908
Expense / cow	37.9	53.4	48.1	37.3	52.4	50.1	37.6	52.9	49.1
Marginal net income, per cow, $	587	570	588	680	661	663	633	615	625
MNI, percent of control,, %	100	97.1	98.9	100	97.2	97.5	100	97.2	98.7