Effects of a Sunflower Seed Supplement on Performance and Reproduction of Beef Cows

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Story in Brief

An experiment was conducted to evaluate the performance and reproductive responses by gestating beef cows to replacing conventional winter supplements with a moderate protein-high oil supplement (whole sunflower seed). During late gestation, 160 multiparous spring calving beef cows were fed one of three supplements. The supplementation period lasted 76 d. Supplements included: 1) 2.25 lb/d of whole sunflower seed; 2) 0.95 lb/d of soybean meal; and 3) 4.19 lb/d of a soybean hull supplement. Each supplement was formulated to provide similar amounts of crude protein and ruminally digested protein. The soybean hull based supplement was also formulated to provide the same amount of energy as the sunflower seed supplement. At the end of the supplementation period cows consuming soybean hulls and soybean meal gained 49 and 26 lb more than cows consuming sunflower seed, respectively. At the beginning of the breeding season cows consuming soybean hulls lost 25 lb more than cows consuming sunflower seed. No difference in cow weight change was observed among treatments at weaning. Furthermore, no difference in cow body condition score was observed among treatments at the end of the supplementation period, at the start of the breeding season, or at weaning. No differences among treatments were observed for calf birth weight, calf-weaning weight, percent of cows cycling at the start of the breeding season, or pregnancy rate. In this experiment, 1st service conception rate was improved with the sunflower and soybean hull based supplements.

Key words: Beef, Cows, Fat Supplementation

Introduction

Limited research suggests that fat supplementation during gestation may improve reproductive efficiency of beef cows (Bellows et al., 2000; Graham et al., 2001). This potential improvement in reproduction could be due to increased energy intake during late gestation. Alternatively, fat supplements may have non-energetic effects on reproduction through the enhancement of pituitary and (or) ovarian function. Whole sunflower seeds have several desirable supplement characteristics; including a high concentration of fat, a moderate concentration of protein, and excellent storage and handling characteristics. However, when cows consume low to moderate quality forage, excessive fat supplementation may reduce dry matter intake and fiber digestion (Jenkins, 1993). The objective of this study was to determine the effects of feeding high-fat whole sunflower seed during late-gestation on performance and reproduction of beef cows.

Materials and Methods

During the winter of 2001-2002, 160 multiparous spring calving Angus x Hereford beef cows were grouped by age (avg = 8.8 yr; range = 4 to 13 yr), weight, and body condition score (BCS) and assigned within groups to dietary treatments in a completely randomized design to determine responses to three late-gestation supplements on cow and calf performance. This experiment was conducted at the Range Cow Research Center, North Range Unit located approximately 10 mi West of Stillwater, Oklahoma. During the 76-d supplementation period (November 30 through February 14) cows were grazed together in a single pasture and had free choice access to a mineral supplement, bermudagrass hay, prairie hay (Table 1), and water.

Table 1. Chemical composition of hay fed during the supplementation period			
	Hay type		
Item	Bermudagrass 1	Bermudagrass 2	Prairie
CP, % of DM	6.5	8.4	4.9
ADF, % of DM	37.5	41.1	38.5
NDF, % of DM	69.5	70.7	68.1
TDN, % of DM	56	56	56
Number of bales fed[a]	99	36	35
Feeding period	12/3/01 through 2/4/02	2/4 through 2/14/02	12/3/01 through 1/6/02
[a]Round bales weighed approximately 1525 lb			

Supplements included: 1) 0.95 lb/d of soybean meal (**NCON,** AF basis); 2) 4.19 lb/d of a soybean hull based supplement (**PCON,** AF basis); and 3) 2.25 lb/d of whole full fat sunflower seed (**WSUN,** AF basis). At this feeding rate, the sunflower seed treatment provided 0.9 lb of fat per day. Each supplement was formulated to provide similar amounts of CP and ruminally digested protein (Table 2). In addition, PCON was formulated to be isocaloric to WSUN (Table 2). Cows were individually fed the appropriate supplement on Monday, Tuesday, Thursday, and Saturday mornings. The amount of supplement fed on each of these 4 d was determined by calculating the amount of supplement needed on a weekly basis (daily supplement amount x 7 d) and dividing that amount by 4 (i.e., cows receiving WSUN were fed 3.94 lb of sunflower seed per feeding). Cows had free choice access to a mineral supplement (NaCl 41.77%, Ca 9.15%, P 8.05%, Mg 0.26%, Cu 1004 ppm, Se 12 ppm and Zn 3006 ppm, AF basis) at all times. Following the 76-d supplementation period, all cows were grazed in a common pasture.

Individual weights and BCS of the cows were determined at the beginning and end of the supplementation period, at the onset of breeding and at weaning.

Table 2. Supplement composition and amount of nutrients supplied daily			
	Treatment		
Item	NCON[a]	PCON[a]	WSUN[a]
Whole sunflower seed, % of DM	-	-	100
Soybean meal, % of DM	100	-	-
Soybean hulls, % of DM	-	94.75	-
Wheat middlings, % of DM	-	5.25	-
CP supplied, lb/d	.46	.47	.46
DIP supplied, lb/d	.33	.36	.35
NE_m, Mcal/d	.83	3.17	3.27
Fat, lb/d	.01	.08	.92
[a]NCON = negative control, PCON = positive control, WSUN = whole sunflower seed			

Milk production was determined using the earliest calving cow/calf pairs from each treatment and the weigh-suckle-weigh technique. Milk composition was determined using five cows from each treatment and a portable milking machine.

The 72-d calving season lasted from February, 12, to April 25, 2002, (avg calving date: March 7, 2002). Percent of cows cycling at the start of the breeding season was determined by measuring progesterone concentration in plasma samples obtained 9 d before and on the first d of the breeding season. The 67-d breeding season began on May 9, and lasted until July 15, 2002. Pregnancy rate was determined by rectal palpation at weaning. Birth weight (BW) of each calf was determined within 24 h of birth and weaning weights (WW) were determined on October 14, 2002.

Statistical Analysis

Cow Performance, Milk Production, and Calf Performance. Cow was considered to be the experimental unit because supplements were fed individually. Data were analyzed using MIXED MODEL procedures of SAS (SAS Inst. Inc., Cary, NC). The initial model included treatment and calf sex as fixed effects and sire as a random effect. Cow age was used as a covariate for all dependent variables. Calf age was also used as a covariate in the calf WW model. Least squares means were separated using the least significant difference procedure of SAS.

Cow Reproductive Performance. A 2 x 3 contingency table was developed for proportion differences among treatments for pregnancy rate, percent cycling, and first service conception rate and tested using a chi-square test. Data were analyzed using FREQ procedures of SAS.

Results

Cow Weight and BCS Change. During the supplementation period, cows consuming PCON gained 23 lb more ($P<.05$) than cows consuming NCON and 49 lb more ($P<.05$) than cows consuming WSUN (Table 3). Evidently, supplemental energy in the form of fermentable carbohydrate was more effective in improving energy status compared to supplemental energy in the form of fat. Cows consuming NCON gained 26 lb more ($P<.05$) than cows consuming WSUN. Since these two treatments were designed to deliver approximately the same amount of degradable protein, this difference in cow BW change may indicate that fat from sunflower seeds reduced forage intake and digestion or that protein in sunflower seeds was not as readily available (Jenkins et al., 1993). In addition, part of this difference may be due to reduced consumption of WSUN by some cows. This palatability problem observed with some cows may be reduced or eliminated by mixing the sunflower seed with other supplements. A treatment difference in cow weight change was also observed from the end of supplementation to the start of breeding. Cows consuming WSUN loss 25 lb less ($P<.01$) than cows consuming PCON. No difference in cow weight change was observed at weaning (Table 3). Similarly, no difference in cow BCS was observed among treatments at the end of the supplementation period, at the beginning of the breeding season, or at weaning (Table 3).

Table 3. Effect of winter supplement on cow weight change (WC) and body condition score (BCS)

	Treatment				
Item	NCON[e]	PCON[e]	WSUN[e]	SEM	P-Value
n=	51	45	46		
Initial weight, lb (11/30/01)[a]	1294	1298	1297	19	.98
WC, supplementation period, lb[b]	49[g]	72[f]	23[h]	5.9	<.01
WC, start of breeding, lb[c]	-256 [fg]	-271[f]	-246 [g]	10	.02
WC, weaning, lb[d]	97	92	102	10	.62
Final weight, lb (10/23/02)	1179	1195	1177	18	.74
Initial BCS (11/30/01)	5.6	5.5	5.6	.1	.75
BCS, end of supplementation (2/14/02)	5.4	5.4	5.1	.1	.15
BCS, start of breeding (5/9/02)	4.9	4.9	4.7	.1	.34
BCS, weaning (10/23/02)	4.9	4.8	4.6	.1	.06

[a]Start of supplementation period (11/30/01)
bWeight change from 11/30 through 2/14/02 (Supplementation period)
[c]Weight change from 2/14 through 4/30/02 (Start of breeding season)
[d]Weight change from 4/30 through 10/23/02 (Weaning)
[e]NCON = negative control, PCON = positive control, WSUN = whole sunflower seed
[fgh]Means within a row with the same letter are not different (P<.05)

Milk Production and Composition. A treatment by calf sex interaction in milk production during early lactation was detected (P=.03; Table 4). Although no differences among the treatments in milk production were observed among cows with female calves (P=.67), cows with male calves consuming either NCON or PCON produced more (P<.05) milk than cows consuming WSUN. At mid-lactation, no treatment x calf sex interaction or treatment differences were detected (Table 5). However, cows with female calves produced more milk than cows with male calves (16.5 vs 13.9 lb/d; P=.02) during this period. No differences among treatments in milk composition were detected (Table 6).

Table 4. Effect of winter supplement and calf gender on early-lactation milk production (4/10/02, lb)

		Treatment				
		NCON[e]	PCON[e]	WSUN[e]	SEM	P-Value
Calf Gender	n=	21	21	20		
Female	23	13.9	14.7	15.8	1.6	.67
Male	39	16.0[b]	17.1[b]	11.8[c]	1.1	<.01
SE		1.3	1.4	1.6		
P-Value[d]		.25	.17	.04		

[a]NCON = negative control, PCON = positive control, WSUN = whole sunflower seed
[bc]Means within a row with the same letter are not different (P<.05)
[d]P-value comparing means within a column

Table 5. Effect of winter supplement on mid-lactation milk production (6/18/02)

	Treatment				
Item	NCON[a]	PCON[a]	WSUN[a]	SEM	P-Value
n =	21	21	20		
Milk production, lb	15.0	15.6	14.9	1.0	0.88

[a]NCON = negative control, PCON = positive control, WSUN = whole sunflower seed

Table 6. Effect of winter supplement on milk composition

	Treatment				
Item	NCON[a]	PCON[a]	WSUN[a]	SEM	P-Value
n =	5	5	5		
Yield, lb	7.2	7.0	8.0	.90	.72
Butterfat, %	2.53	2.34	2.66	.31	.77
Protein, %	3.24	2.87	2.97	.13	.13
Lactose, %	5.50	5.53	5.47	.06	.80
SNF[b], %	10.14	9.75	9.79	.15	.19
SCC[b], white blood cells/mL	31	73	41	35	.69
MUN[b], mg/dL	2.76	1.83	2.49	.36	.21

[a]NCON = negative control, PCON = positive control, WSUN = whole sunflower seed
[b]SNF = solids not fat; SCC = somatic cell count; MUN = milk urea nitrogen

Calf Performance. No treatment x calf sex interaction was observed for BW or WW and no treatment differences in calf BW or calf WW were detected (Table 7). However, at birth, female calves were lighter (74.3 vs 81.7 lb; P< .01) than male calves. Female calves also were lighter (497.8 vs 523.4 lb; P<.01) at weaning compared to male calves.

Table 7. Effect of winter supplement on calf birthweight (BW) and weaning weight (WW)

	Treatment				
Item	NCON[a]	PCON[a]	WSUN[a]	SEM	P-Value
n =	51	45	46		
Calf BW, lb	77.4	79.8	76.8	1.75	.35
Calf WW, lb	502.9	515.5	513.5	12.74	.42

[a]NCON = negative control, PCON = positive control, WSUN = whole sunflower seed

Cow Reproductive Performance. No differences in percent of cows cycling at the start of the breeding season (57%) or in pregnancy rate (88%) were observed among treatments (Table 8). However, first service conception rates were higher (P<.05) for PCON and WSUN when compared to NCON.

Table 8. Effect of winter supplement on cow reproductive performance

	Treatment		

Item	NCON[a]	PCON[a]	WSUN[a]	SEM	P-Value
n =	51	45	46		
Cows cycling, %	53	67	52	7.4	.29
Pregnancy rate, %	84	91	91	5.1	.46
n =	44	39	36		
1st service conception rate, %	55	80	75	7.5	.03
[a]NCON = negative control, PCON = positive control, WSUN = whole sunflower seed					

Implications

Under the conditions of this experiment, whole sunflower seed was not as effective of a winter supplement compared to soybean meal or soybean hull supplements when weight change during the feeding period was evaluated. Reduced cow performance during the supplementation period could be due to excessive fat provided by the sunflowers, reduced supplemental protein availability, or a combination of the two. If so, supplementing sunflower seed at a lower rate and (or) processing the seed prior to feeding may improve performance during supplementation. However, whole sunflower seed fed during gestation was effective in improving first service conception rates, even in the presence of lower winter weight gain compared to the other supplement treatments.

Literature Cited

Bellows, R.A. et al. 2000. J. Anim. Sci. 78 (Suppl. 1): 957 (Abstr).

Graham, et al. 2001. J. Anim. Sci. 79 (Suppl. 2): 340 (Abstr).

Jenkins, et al. 1993. J. Dairy Sci. 76:3851-3863.

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