# Effects of High-linoleic and Mid-oleic Sunflower Grain Supplements on Performance and Reproduction of Beef Cows and their Calves

J.P. Banta, D.L. Lalman, C.R. Krehbiel, and R.P. Wettemann

## Story in Brief

An experiment was conducted to evaluate the performance and reproductive responses by gestating beef cows to replacing conventional winter supplements with whole sunflower grain. During late gestation, 118 multiparous spring calving beef cows were fed one of three supplements for an average of 83 d. Treatments included: 1) 3.0 lb/d of a soybean hull based supplement (Positive**,** 94.75% soybean hulls, 5.25% wheat middlings); 2) 1.6 lb/d of high-linoleic sunflower grain and 0.6 lb/d of the Positive supplement (Linoleic); and 3) 1.5 lb/d of mid-oleic sunflower grain and 0.6 lb/d of the Positive supplement (Oleic). Each supplement was formulated to provide similar amounts of crude protein, degradable intake protein and energy. During the first 62 d of the treatment period, cows fed Positive gained 25 lb; whereas cows fed Linoleic only gained 7 lb and cows fed Oleic lost 7 lb. However, late-gestation supplement did not influence cow weight change during the remainder of the year or cow weight at weaning. Additionally, body condition score before calving, at the start of the breeding season, and at weaning was not influenced by late-gestation supplement. Furthermore, treatment had no effect on calf birth weight, calf weaning weight, or feedlot performance and carcass characteristics of steer calves. Although, more cows fed Positive were cycling at the start of the breeding season, no difference in first service conception rate or pregnancy rate were detected among treatments.

Key words: Beef, Cows, Fat Supplementation

## Introduction

The economic value of reproduction has been estimated to be substantially greater compared to production or end product traits (Melton, 1995). Consequently, maximizing reproductive efficiency is critical to maintain a viable cow/calf enterprise. Fat supplementation has been evaluated as a nutraceutical to improve reproductive efficiency through increased functional capability of the ovary and/or reduced $PGF_{2\alpha}$ synthesis by the uterus (Williams and Stanko, 2000). Limited research suggests that fat supplementation during late-gestation may improve reproductive efficiency of beef cows (Bellows et al., 2000; Graham et al., 2001).

Whole sunflower seeds have several desirable supplement characteristics, including a high fat concentration, a moderate concentration of protein, and excellent storage and handling characteristics. However, excessive fat supplementation may reduce forage intake and fiber digestion (Jenkins, 1993). The first objective of this study was to determine the effects of feeding high-fat whole sunflower grain, during late-gestation, on performance and reproduction of beef cows and performance of their calves. The second objective was to determine if the fatty acid profile of whole sunflower grain had an effect on performance and reproduction of beef cows and performance of their calves.

## Materials and Methods

During the winter of 2002-2003, 118 multiparous spring calving Angus x Hereford beef cows were ranked by age (avg = 8.8 yr; range = 4 to13 yr), and body condition score (BCS) and assigned to dietary treatments in a completely randomized design to determine responses to three late-gestation supplements on cow and calf performance.  Supplementation of treatments started on December 3, 2002, and ended at calving or on February 26, 2003, whichever came first (avg supplementation = 83 d; range = 69 to 85 d).

Treatments included: 1) 3.0 lb/d of a soybean hull based supplement (Positive**,** AF basis; 94.75% soybean hulls, 5.25% wheat middlings); 2) 1.6 lb/d of high-linoleic sunflower grain (CP, 18.3%; EE, 43.5%, DM basis) and 0.6 lb/d of the Positive supplement (Linoleic**,** AF basis); and 3) 1.5 lb/d of mid-oleic sunflower grain (CP, 19.9%; EE 42.9%, DM basis) and 0.6 lb/d of the Positive supplement (Oleic**,** AF basis).  Each supplement was formulated to provide similar amounts of energy, crude protein and degradable intake protein (Table 1). A small amount of the Positive supplement was included in the Linoleic and Oleic treatments to improve the palatability of these treatments.  In a previous experiment, some palatability problems were experienced with whole sunflower seeds (Banta et al., 2003). Cows were individually fed the appropriate treatment 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 four. During the treatment period, cows were maintained in a single pasture and had free choice access to a mineral supplement (Salt, 24.6%; Ca, 16.8%; P, 8.7%; Cu, 1038 ppm; Zn, 3099 ppm; and Se, 12 ppm; DM basis), bermudagrass hay (CP, 8.3 %; ADF, 41 %, DM basis) and water.  During the remainder of the experiment, cows were grazed in a common pasture and had free choice access to a mineral supplement at all times.

**Table 1.  Supplement composition and amount of nutrients supplied daily**

| | Treatment | | |
|---|---|---|---|
| Item | Linoleic | Oleic | Positive |
| High-linoleic sunflower grain, lb of DM | 1.50 | - | - |
| Mid-oleic sunflower grain, lb of DM | - | 1.41 | - |
| Soybean hull based supplement, lb of DM | .5 | .5 | 2.71 |
| CP supplied, lb/d | .34 | .34 | .34 |
| TDN supplied, lb/d | 2.18 | 2.07 | 2.08 |
| Fat, lb/d | .67 | .63 | .06 |

Individual weight and BCS (1 = emaciated, 9 = obese) of each cow was determined at the beginning of the treatment period, after the first 62 d of the treatment period (before any cows had calved), at the onset of breeding and at weaning.

The 72-d calving season lasted from February 10 to April 22, 2003, (avg calving date: March 9, 2003). Percent of cows cycling at the start of the breeding season was determined by measuring progesterone concentration in plasma samples obtained 10 d before and on the first d of the breeding season. The 65-d breeding season began on May 12 and lasted until July 16, 2003. Cows were bred using artificial insemination from May 12 through June 13, followed by natural mating from June 13 through July 16. First service conception rate was determined using transrectal ultrasonography approximately 30 d after artificial insemination. Pregnancy rate was determined by rectal palpation at weaning. Birth weight of each calf was determined within 24 h of birth and gross weaning weight was determined on October 2, 2003.

At weaning all steer calves were transported to the Willard Sparks Beef Research Center to determine the effects of late-gestation cow nutrition on subsequent calf feedlot performance and carcass characteristics. Steers were randomly assigned to pens based on treatment and fed a high-concentrate finishing ration for 190 d until harvest. Feedlot arrival and out weight were determined on each steer and a 4% pencil shrink was applied to these weights to calculate shrunk in weight, shrunk out weight, and ADG. Steers were harvested at Excel Corporation (Dodge City, KS) and chilled for 72 h before collection of carcass data.

## Statistical Analysis

***Cow 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 as a fixed effect and cow age as a covariate. The calf performance data were analyzed using calf sex as a fixed effect and calf sire as a random effect. Calf age was also used as a covariate in the calf weaning weight 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.

***Feedlot Performance and Carcass Characteristics.*** Steer was considered to be the experimental unit because treatments were individually fed to their dams during late-gestation. Data were analyzed using MIXED MODEL procedures of SAS. The model included treatment as a fixed effect and calf sire as a random effect. In addition, cow and calf age were included as covariates. Least squares means were separated using the least significant difference procedure of SAS. A 2 x 3 contingency table was developed for proportion differences among treatments for percent choice or greater and tested using a chi-square test. Proportion data were analyzed using FREQ procedures of SAS.

## Results and Discussion

***Cow Weight and BCS.*** Supplements were readily consumed by all cows throughout the treatment period. During the first 62 d of the treatment period, cows fed Positive gained 18 lb more ($P<.05$) than cows fed Linoleic and 32 lb more ($P<.05$) than cows fed Oleic (Table 2). Additionally, cows fed Linoleic gained 14 lb more ($P<.05$) than cows fed Oleic (Table 2).

However, there were no differences in weight change during the subsequent weigh periods or cow weight at weaning (Table 2). Furthermore, late-gestation supplement did not influence BCS throughout the experiment (Table 2).

| Table 2. Effect of late-gestation supplement on cow weight change (WC) and body condition score (BCS) | | | | | |
|---|---|---|---|---|---|
| | Treatment | | | | |
| Item | Linoleic | Oleic | Positive | SEM[c] | P-value |
| Number of cows | 41 | 37 | 40 | | |
| Length of treatment period, d | 83 | 83 | 82 | .7 | .73 |
| Initial weight, lb (12/3/02) | 1274 | 1269 | 1273 | 22 | .99 |
| Treatment WC, lb (12/3 to 2/3/03)[a] | 7[y] | -7[z] | 25[x] | 5 | <.01 |
| WC to breeding, lb (2/3 to 5/12/03) | -146 | -140 | -141 | 7 | .83 |
| WC to weaning, lb (5/12 to 10/2/03) | 69 | 72 | 57 | 7 | .28 |
| Overall WC, lb (12/3/02 to 10/2/03) | -70 | -75 | -60 | 9 | .49 |
| Final weight at weaning, lb (10/2/03) | 1204 | 1194 | 1213 | 21 | .80 |
| | | | | | |
| Initial BCS, (12/3/02) | 5.0 | 5.1 | 5.0 | .1 | .80 |
| Treatment BCS, (2/3/03)[b] | 4.9 | 4.9 | 5.0 | .1 | .53 |
| Start of breeding BCS, (5/12/03) | 4.7 | 4.7 | 4.8 | .1 | .51 |
| Final BCS at weaning, (10/2/03) | 4.9 | 5.0 | 4.9 | .1 | .73 |

[a]Weight change during the first 62 d of the treatment period before any cows calved.
[b]BCS: 1= emaciated, 9 = obese.
[c]Most conservative standard error of the mean (n=37).
[xyz]Within a row, means without a common superscript letter differ (P<.05).

***Calf Performance*.** Late-gestation supplement did not influence calf birth weight (78 lb) or weaning weight (504 lb; Table 3). However, female calves were 6 lb lighter at birth than male calves (75 vs 81 lb; P<.01) and 20 lb lighter at weaning than steer calves (490 vs 511; P=.03).

| Table 3. Effect of late-gestation supplement on calf birth weight and weaning weight | | | | | |
|---|---|---|---|---|---|
| | Treatment | | | | |
| Item | Linoleic | Oleic | Positive | SEM[b] | P-value |
| Number of calves | 41 | 37 | 40 | | |
| Calf birth weight, lb | 76 | 79 | 79 | 1.8 | .46 |

| | | | | | |
|---|---|---|---|---|---|
| Calf weaning weight, lb[a] | 504 | 501 | 496 | 19 | .74 |

[a]Gross weaning weights are reported (avg calf age = 207 d).
[b]Most conservative standard error of the mean (n=37).

***Cow Reproductive Performance***. At the start of the breeding season, more cows fed Positive were cycling (43%) compared with cows fed Linoleic (20%) or Oleic (16%; Table 4; $P<.05$). However, late-gestation supplement did not influence first service conception (67%) or pregnancy rate (93%; Table 4).

| Table 4. Effect of late-gestation supplement on cow reproductive performance | | | | |
|---|---|---|---|---|
| | Treatment | | | |
| Item | Linoleic | Oleic | Positive | P-value |
| Number of cows | 41 | 37 | 40 | |
| Days from calving to start of the breeding season | 64 | 64 | 63 | .95 |
| Cows cycling at the start of the breeding season, % | 20[y] | 16[y] | 43[x] | .02 |
| Pregnancy rate at weaning, % | 98 | 86 | 93 | .18 |
| | | | | |
| Number of cows | 34 | 27 | 31 | |
| First service conception rate, % | 76 | 56 | 68 | .22 |
| [xy]Within a row, means without a common superscript letter differ (P<.05). | | | | |

***Feedlot Performance and Carcass Characteristics.*** Supplements fed to cows during late-gestation did not influence feedlot performance or carcass characteristics of steer calves (P>.11; Table 5).

| Table 5. Effect of late-gestation supplement on steer feedlot performance and carcass characteristics | | | | | |
|---|---|---|---|---|---|
| | Treatment | | | | |
| Item | Linoleic | Oleic | Positive | SEM[a] | P-value |
| Number of steers | 19 | 22 | 20 | | |
| Feedlot in weight, lb | 496 | 475 | 472 | 27 | .31 |
| Feedlot out weight, lb | 1182 | 1145 | 1187 | 22 | .31 |
| ADG, lb | 3.58 | 3.54 | 3.73 | .09 | .26 |
| Hot carcass weight, lb | 742 | 724 | 747 | 16 | .45 |
| Backfat thickness, in | .69 | .69 | .66 | .05 | .83 |
| Ribeye area, $in^2$ | 11.8 | 11.7 | 12.4 | .3 | .11 |
| Kidney, pelvic, heart fat, % | 2.6 | 2.8 | 2.4 | .2 | .11 |
| Calculated yield grade | 3.77 | 3.80 | 3.49 | .18 | .39 |

| | | | | | |
|---|---|---|---|---|---|
| Marbling score, Small 00 = 40 | 40 | 43 | 42 | 1.7 | .33 |
| % Choice or greater | 68 | 86 | 65 | - | .24 |
| [a]Most conservative standard error of the mean (n=19). | | | | | |

## Literature Cited

Banta, J. P. et al. 2003. Okla. Agr. Exp. Sta. Res. Rep. P-998.

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.

Melton, B. E. 1995. Proc. Beef Improvement Federation 27th Research Symposium and Annual Meeting, Sheridan, Wyoming. pp. 40-71.

Williams, G. L., and R. L. Stanko. 2000. Proc. Amer. Soc. Anim. Sci. 1999. Available at: www.asas.org/jas/symposia/proceedings.

## Acknowledgements

The authors would like to thank Joe Steele and Duane Williams for their management and feeding of the cowherd throughout the study. The authors would also like to thank the staff at the Willard Sparks Beef Cattle Research Center for care and management of the feedlot steers. Additionally, a great deal of gratitude is extended to Pioneer Hi-Bred International, Inc., for providing funding for this study.



Authors

Banta, J.B. – Graduate Student

Krehbiel, C.R. – Associate Professor

Lalman, D.L. – Associate Professor

Wettemann, R.P. – Regents Professor