COMPARISON OF POURED PROTEIN PRODUCT AND WHOLE COTTONSEED AS SUPPLEMENTS FED TO BEEF COWS DURING WINTER[1]

G. M. HILL[2], M. A. POORE[3], S. V. TUCKER[2], D. J. RENNEY[2], M. A. PENCE[4], AND B. G. MULLINIX, JR.[5]

ABSTRACT

In 2007, 78 pregnant beef cows (Brangus and Braford, Brahman derivatives; > 4 yr of age) were assigned to 6 groups based on BW, age, and breeding, before groups were randomly assigned to six dormant summer perennial grass pastures. Cows were assigned to one of three treatments: 1) Hay only (H); 2) Hay plus commercial hot-poured protein tubs (HP; 24% CP, Sweetlix, Mankato, MN), or 3) Hay plus whole cottonseed (HWCS) at a rate of 0.5% of cow BW daily. Mixed bermudagrass hay was fed free-choice in hay rings in each pasture. Cows continued on the 3 treatments for 90 days, December 19, 2006 through the end of calving season (D 90; March 19, 2007). Cows were weighed on two consecutive days on D1, D 90, D 190 (June 26 and 27). Ultrasound rib and rump fat and BCS were recorded on D1 before assignment to treatment pastures, D 90 and D212 (July 19, 2007). During the breeding season (79 d; March 26 to June 13, 2007), cows were exposed to fertile bulls. Hay disappearance, cow weight change, changes in ultrasonic fat depth over the 13th rib and rump, change in cow body condition score, and pregnancy rates were determined. Cows were calving during the supplementation period, which influenced cow (BW) and body condition. Cows on HWCS were fed 6.54 lb cottonseed/day, and Cows on HP consumed 0.59 lb of protein product daily, much below manufacturer estimates of 1 to 2 lb/cow daily. Hay (92% DM, 13.1% CP, 71.1% NDF, 55.2% TDN) disappearance tended (P < 0.38) to be lower for HWCS cows, compared with H cows and HP cows (34.1 vs. 39.1 and 38.2 lb/d). After the 90-d supplementation period, the HWCS cows had higher ADG than HP cows, and HP cows had higher ADG than H cows (ADG, lb = HWCS 0.66, HP 0.9, H -0.23 lb; P < 0.01). However, ultrasound rib and rump fat were similar at D 90 for all cows. During the next 100 days, including the breeding interval and the extreme drought of Spring, 2007, cows on all treatments lost BW and body condition. Cows on HWCS that had higher D 90 ADG, tended to lose more during this interval, but their D 190 BW were only 14 lb lower than on D 1, compared with 37 lb and 46 lb reductions for cows on HP and H, respectively. Pregnancy rates determined 45 d after the breeding interval were similar for all treatments (% pregnant: H = 89.2; HP = 96.3; HWCS = 87.6; P > 0.14). Calf weaning and 205-d adjusted weaning weights, and calf ADG from birth to weaning were unaffected by dietary treatment. Producers should determine CP in hay, and compare cost of energy and protein in cottonseed to that supplied by commercial protein supplements.

---

[1]Research supported in part by a grant from Cotton, Inc., Cary, NC.
[2]Animal and Dairy Science Dept., Univ. of Georgia, Tifton Campus;
[3]Dept. of Animal Sciences, North Carolina State Univ., Raleigh;
[4]Vet. Diagnostic Laboratory, Tifton Campus,
[5]Experimental Statistics Dept., Tifton Campus.

INTRODUCTION

Each year beef cows across the Southeastern USA are fed hay during winter as a primary feedstuff while pastures are dormant. Much of the hay grown across the region is inferior in quality, providing lower nutrient content and digestibility than the requirements of pregnant or spring calving beef cows. Supplementation with sources of energy and protein increases nutrient content of diets and may enhance hay digestibility. Several companies have protein supplement products, usually with molasses-based carriers with added urea and natural protein sources, with varying levels of fat added for energy. Recently, weather-resistant hot-poured protein products (24% or 32% CP, 250 or 500 lb containers) often with intake limiters, have increased in popularity, replacing stationary lick-wheel tanks for liquid molasses-based products on many farms.

Whole cottonseed have been fed to beef cattle as a winter supplement for many decades, and it is an good source of protein, energy and phosphorus, which are often limited in low-quality hay diets (Rogers et al., 2002). Whole cottonseed are locally available in many locations across the Southeastern USA, and they are compact, easy to feed, and require no processing before feeding (Rogers et al., 2002). Cottonseed have been relatively cheap if purchased directly from the gins at harvest over the last 2 decades, but in 2007 the combination of drought reduction in cotton yields, reduced acreage planted, price competition from corn, soybean products, and increased demands from the dairy and manufacturing industries have greatly increased cottonseed prices, even at harvest. Cottonseed provides both energy and protein (96% TDN and 23% CP, Feedstuffs, 2001). Research has indicated that cottonseed has a value similar to a 20% CP mixture of corn and soybean meal (Poore and Rogers, 1998). Beef cows can utilize cottonseed and hay very well, but younger growing cattle had diminished performance on cottonseed/hay diet compared with a corn/cottonseed meal diet (Hill et al., 2003; 2004), and performance decreased when cottonseed were fed at greater than 15% of diet DM in heifer diets (Poore, 1994). Cottonseed should be limited in diets of beef cows, because Hill et al. (2007) reported that cows fed cottonseed free-choice had 2-yr average cottonseed DMI of 9.04 lb/d (4.1 kg/d), considerably higher than the accepted recommendation for cottonseed feeding to mature beef cows of 0.5% BW, or 5.1 to 7.1 lb/cow daily (Rogers et al., 2002). Overfeeding cottonseed by self-feeding to beef cows may reduce dietary fiber digestion (Hill et al., 2007), and become cost prohibitive.

A study was designed to determine the potential value of cottonseed as a supplement compared with a hot-poured molasses protein product fed as supplements with hay to beef cows, beginning just prior to initiation of calving, and continuing until the spring breeding season began. Hay and supplement intake, cow and calf gain, cow body fat changes, calf weaning weights, and cow pregnancy rates were determined.

MATERIALS AND METHODS

Cows and Treatments

Seventy eight pregnant mature (> 4 yr of age) beef cows (Brangus and Braford, Brahman derivatives) were assigned to six groups based on December body weight (BW), age, and breeding, before groups were randomly assigned to six paddocks of dormant pastures that were bermudagrass and bahiagrass mixtures. Cows were fed one of three treatments: 1) Hay only (H); 2) Hay plus commercial hot-poured protein tubs (HP; 24% CP, Sweetlix, Mankato, MN), or 3) Hay plus whole cottonseed (HWCS) at a rate of 0.5% of cow body weight daily. Mixed bermudagrass hay was fed free-choice in hay rings in each pasture. Cows were weighed on two consecutive days to reduce ruminal fill effects on BW, body condition scored visually, and rib fat and rump fat were measured by ultrasound before assignment to treatment pastures on December 18 and 19, 2006, about 2 weeks prior to the initiation of calving season (January 1). Cows continued on the 3 treatments for 90 days, through the end of calving season (March 19, 2007). Cows were weighed on 2 consecutive days on d 89 and 90 (March 18 and19, 2007), and again at d190 (June 26 and 27, 2-wk after end of breeding season). Ultrasonic fat (USF) depth over the 13^{th} rib and rump and BCS (scale 1= emaciated; 9 = obese) were recorded on d 90 (March 19, 2007) and d190 (June 27, 2007).

During the breeding season (79 d; March 26 to June 13, 2007), cows were assigned to different pastures with similar forage availability and species, depending on breed of bull to be used to service cows. Cows were exposed to either Angus or Brangus bulls that had passed BSE examinations. Periodic samples of cottonseed, hay, and supplement were analyzed for nutrient content and DM. A commercial mineral containing at least 8% P and salt was available free-choice to all cows. Pregnancy rates were determined by rectal palpation of cows verified by ultrasound 45 days after the breeding season ended. Calf weight change from birth to the end of supplementation period, March 15 to end of breeding interval, from birth to end of breeding season, and birth to weaning were determined. Cows and calves were reassigned to summer grazing treatments with regard to the original supplementation treatments, from June to weaning on September 13, 2007, when cow and calf weaning weights and BCS of cows were determined. Hay disappearance, cottonseed intake, and supplement intake were carefully measured during the supplemental period. Hay, poured protein tub product, and cottonseed were periodically sampled and chemically analyzed (Tables 5, 6 and 7) for DM and CP using AOAC (1990) procedures, and ADF and NDF were determined using methods outlined by Van Soest et al. (1991).

Statistical Analyses

The cow performance data (BW, ADG, BCS, and USF) and reproductive data were analyzed using Proc MIXED (SAS, 2002). The BW and reproductive data were in one analysis, with means adjusted for these covariables when appropriate: cow initial BW; age of cow (AOD); cow breed type (Brangus, Braford, ¾ Angus1/4Brahman); calf birthweight; calf BW at d 90; calf age at d 90; calf breed type (Brangus, Angus X Braford, Angus crossbred calves). Calf performance data were analyzed using Proc Mixed (2002), with means adjusted for covariables: cow initial BW, age of cow (AOD), calf birthweight, calf breed type, calf BW at d 90, calf age at d 90 when appropriate.

RESULTS AND DISCUSSION

The supplementation study was conducted without major incident, with cows assigned to supplement treatments about 2 wk before calves began to arrive in January, 2007. Cows on each treatment were calving throughout the supplementation period, which might have influenced both cow BW and body condition scores (BCS). At the end of the 90-d supplementation period, cows on HWCS had greater ($P < 0.05$) average BW than cows on H (Table 1). The HWCS had higher ($P < 0.05$) ADG than HP cows, and HP cows had higher ($P < 0.05$) ADG than H cows. In Table 2, cows on the HWCS treatment had higher visual BCS on D 90 than cows on HP or H, which supports the increased ADG noted for HWCS cows during the supplementation period (Table 1). However, ultrasound fat depths over the rib and rump of the cows were similar at D 90 for all treatments. This may be explained by the fact that these measurements were taken at single sites on the cow body, whereas the BCS scores take into account the overall condition of the cow all along the back, tailhead, brisket, and over the ribs. Cows on H actually had BW and ADG losses (Table 1) during the supplementation period, while those on HP had slightly positive ADG. These results indicate that feeding WCS to late pregnancy beef cows increased ADG and BW during the pre-breeding and calving interval, and these gains were higher than those of cows fed either a protein supplement or hay alone. The cows on HWCS had higher performance because of the protein and energy supplied by WCS, even though hay fed on all treatments was of relatively good quality (Table 5; Avg. 13.1% CP on DM basis, 55% TDN).

By D190 and D212, cows on HWCS had returned to approximately the same BW they had initially in December, but cows on H and HP had lower BW on D 190 and D 212 than they had in December. This trend continued through D 268, when cows were weighed at weaning, with HWCS cows approaching their D 1 (December 19) BW, but cows on H and HP still had not regained as much of their initial BW. It is interesting that all cows had negative ADG from D 90 to D 190, and D 90 to D 212 (Table 1), with the largest loss occurring on HWCS, and the smallest on H for each interval. But ADG losses were greater ($P < 0.13$) for H and HP than HWCS from D1 to D268 at weaning. At D 212, BCS and ultrasound fat thickness were similar for all treatments (Table 2). During this interval (from March to June), a record harsh spring drought occurred that resulted in insufficient pasture forages to support cows nursing calves, so hay and pelleted corn gluten feed supplementation was implemented for all cows for approximately 30 days, during the latter part of the breeding season. Relief finally arrived with the first spring rains associated with Tropical Storm Barry supplying 4-5 inches of rain during the first week of June, 2007. Cow pregnancy rates were apparently unaffected by treatments ($P < 0.14$; Table 1), or by the harsh drought conditions, because pregnancy rates were above 88% for each treatment. The average estimated number of days pregnant was similar for all treatments, indicating that supplementation and the harsh drought conditions that lasted through most of the breeding interval did not affect conception dates of cows. According to these estimated fetal ages at time of examination, the average conception dates for H, HP, and HWCS, respectively, were: April 26, May 2, and April 29.

The body condition scores for cows and rib and rump ultrasound fat depth are shown in Table 2 for various key dates and time intervals in the experiment. Initial BCS and ultrasound measurements were virtually equal for each treatment. As mentioned, on D 90 cows on the HWCS treatment had higher ($P < 0.02$) visual BCS than cows on HP or H. However, on D90 and D 212, ultrasound fat depths were unaffected by dietary treatments. The change in ultrasound fat depth was unaffected by treatment at all measurement dates. Cows on all treatments had lower rib and rump fat on D90 than on D1, with negative changes in these fat depots. This is a normal phenomenon observed during calving and early lactation of cows on average beef cattle diets. At D 212, cows on all treatments had higher rib and rump fat than on D90, but rib fat was still lower than the rib fat on D 1. By d 90, rump fat depths were similar to those of cows on D1, and on D 212, rump fat was at or higher than depths in cows on D1. These data indicate that all cows regained their body condition during the breeding interval and the return of green pastures in early June. While the overall change in rib fat depth from D1 to D212 was negative by similar amounts for all treatments, cows were regaining body condition as the season progressed.

Calf performance (Table 3) indicated that calf birthweights and average calf ages tended to be lower for calves on H than calves on HP and HWCS. These effects were functions of the breeding program, and assignment of cows to treatments without knowledge of estimated fetal calf age on D1 of the experiment. Feeding cows hay only on the H treatment might have had lower calf birthweights on this treatment. On D90, calf weights tended to be higher ($P < 0.16$) for calves on HWCS than calves on HP. Calf ADG were similar for all treatments ($P < 0.73$), but numerically higher for the lower birthweight, younger calves on H than HP or HWCS. At D190 and D212, calves were heaviest on H, intermediate on HP, and had the lowest weights on HWCS. Calf ADG for the various time periods displayed the same trends, with highest ADG for H, intermediate for HP and lowest ADG for calves on HWCS. These results might have been influenced by milk production of the cows randomly assigned to the three treatments. Calf weaning weights, 205-d adjusted weaning weights, and calf ADG from birth to weaning (Table 3) were unaffected by dietary treatment. This indicates that while treatments were different in June and July, after pastures regained virility following the spring drought, all calves were able to recover resulting in similar calf weights at weaning. In the weeks prior to weaning, pasture forages were probably as important as waning milk production of cows in sustaining calf gains.

Hay, protein tub supplement and cottonseed consumption are shown in Table 4. Hay consumption or disappearance was consistently lower for cows on HWCS, than for cows on H and HP treatments, which had similar hay disappearance. Hay composition is shown in Table 5, and average crude protein was 13.1% on a DM basis—much higher than the typical bermudagrass hay fed to cows in the Southeastern United States. Hay had average TDN of 55, and fiber components were in acceptable ranges. The higher CP and TDN of this hay probably allowed cows on H to gain and reproduce at higher than expected levels. The cottonseed were fed at a constant daily amount (0.5% BW) on the HWCS treatment (Table 4). The protein supplement intake (Table 4) presented some issues, because one replicate pen of cows on the HP treatment consistently consumed more of the product than the other replicate pen of cows. In Table 6, the nutrient composition of several drilled samples of the protein supplement averaged 30.66% CP on a DM basis, which was very near the 24% CP as-fed stated on the label. However, only 1% fat was found in protein supplement samples (Table 6), when the label stated that the blocks contained 5% fat. Furthermore, the manufacturer predicted on their label that 1000 lb cows should consume 1 to 2 lb of product daily. Cows in this experiment weighed in excess of 1200 lb, and the average treatment consumption of the product was 0.59 lb/cow daily for 90 days. Perhaps, once again, the higher CP of the hay being fed (Table 5) met CP needs of the cows, and tended to reduce intake of the protein supplement. It is also interesting that the replicate treatment group that had lower protein supplement intake also had lower hay intake (Table 4). The chemical analyses of the whole cotton seed are shown in Table 5, and the composition of the cottonseed fed in this experiment is quite typical for CP, averaging 24% CP, but the 69% TDN value is lower than many literature values (Feedstuffs, 2001: 96% TDN; NRC, 1996: 90 % TDN). The lower TDN values are consistent with other cottonseed analyses conducted by Dairy One, Ithaca, NY, and it is apparently related to formulas they use to calculate TDN values. The fat content of the cottonseed tended to be lower than expected in our study, averaging 15.7% ether extract in these samples, but other samples from other experiments usually have fat in the 19 to 22% range.

CONCLUSIONS

Feeding cottonseed at 0.5% BW with hay resulted in higher cow gains and body condition scores during the 90-d winter feeding period than feeding hay with a poured protein supplement or feeding hay alone. All cows lost weight during the 100 d interval after supplementation ended on March 19, 2007, because of a record Spring drought. However, cows fed cottonseed experienced lower BW losses during this interval compared with cows fed hay alone or a protein supplement. Cow pregnancy rates were apparently unaffected by winter supplementation treatments, or by the harsh drought conditions, because pregnancy rates were above 88% for each treatment. Calf weaning weights, 205-d adjusted weaning weights, and calf ADG from birth to weaning were unaffected by dietary treatment. Producers should determine hay crude protein content, and then compare cost of energy and protein in cottonseed with other supplements fed to beef cows in winter.

LITERATURE CITED

AOAC. 1990. Official Methods of Analysis. 15th ed. Assoc. Official. Anal. Chem., Arlington, VA.

Feedstuffs. 2001. Reference Issue. Feedstuffs. Vol.73, No. 29. The Miller Publishing Co., Minnetonka, MN.

Hill, G. M. and R. N. Gates. 2003. Cottonseed and cottonseed meal utilization by growing beef cattle grazing perennial forages in Georgia. 2002 Georgia Cotton Research and Extension Reports, Univ. of Georgia CAES and USDA-ARS, Athens, GA. Pp.3-8.

Hill, G. M., J. F. Baker, B. C. Hand, G. W. Stone, M. Keeler and T. Ingram. 2004. Increasing performance of growing cattle after weaning using cottonseed and cottonseed meal supplements. 2003 Georgia Cotton Research and Extension Reports, Univ. of Georgia CAES and USDA-ARS, Athens, GA. Pp. 35-39.

Hill, G. M, M. H. Poore, M. E. Pence and B. G. Mullinix, Jr. 2007. Performance of beef cows fed free-choice whole cottonseed and hay during winter. J. Anim. Sci. 85 (Suppl. 1): 457 (Abstr.).

Hill, G. M, M. H. Poore, and B. G. Mullinix, Jr. 2007. Digestibility of cottonseed with Tifton 85 hay fed free-choice to beef steers. J. Anim. Sci. 85 (Suppl. 1): 617 (Abstr.).

NRC. 1996. Nutrient Requirements of Beef Cattle. 7th rev. ed. Natl. Acad. Press, Washington, DC.

Poore, M. A. 1994. Whole cottonseed in sorghum-silage based diets for developing heifers. . J. Anim. Sci. 72 (Suppl. 1):382. (Abstr.).

Poore, M. A. and G. M. Rogers. 1998. Alternative feed resources for beef cattle in the southern region of the US. J. Anim. Sci. 76 (Suppl. 1):21. (Abstr.).

Rogers, G. M., M. H. Poore, and J. C. Paschal. 2002. Feeding cotton products to cattle. Alternative Feeds for Beef Cattle. G. M. Rogers and M. H. Poore, ed. Vet. Clin. Food Anim. Practice. 18: 267-294.

SAS. 2002. SAS/C OnlineDOC™, Ver. 8.2. SAS Institute, Inc., Cary, NC.

Table 1. Cow gain performance when fed hay, hay with protein tubs, or hay with 0.5% BW whole cottonseed (WCS) for 90 d in winter.

Item	Trt 1 Hay	Trt 2 Hay + Prot Tub	Trt 3 0.5% BW WCS	SE	Trt *P* <
No. cows (13/replicate)	26	26	26		
Cow initial BW (12/19), lb (Mean of 2 daily BW)	1273.2	1267.3	1274.2		
D 43 cow BW (1/31), lb[d]	1274.8	1320.6	1318.7	17.7	0.31
D 43 cow ADG, lb[d]	0.08	1.14	1.10	0.42	0.32
D 90 cow BW (3/19), lb[d] (Mean of 2 daily BW), at end hay & sup. feeding	1250.9[b]	1278.0[ab]	1331.4[a]	12.7	0.09
D 90 cow ADG, lb[d]	-0.23[c]	0.09[b]	0.66[a]	0.12	0.01
D 190 cowBW(6/27), lb[d,e] (Mean of 2 daily BW)	1227.3	1230.7	1260.3		Trt x BT (P<0.07)
D 190 cow ADG, lb[d,e]	-0.16	-0.18	-0.04		Trt x BT (P<0.05)
D 90-d 190 cow ADG,lb[d] (Calf breed type (P<0.04)	-0.25	-0.50	-0.68	0.15	0.23
D 212 cow BW (7/19), lb[d]	1235.7	1231.4	1262.0	11.25	0.12
D 212 cow ADG, lb[d]	-0.17	-0.19	-0.05	0.06	0.12
D 90-212 cow ADG, lb[d]	-0.16	-0.38	-0.56	0.14	0.25
D268 cow BW at wean, lb	1232.5	1231.9	1261.3	11.91	0.13
D1 to D268 cow ADG, lb	-0.13	-0.13	-0.02	0.04	0.13
Cow Pregnancy Rate, %	89.2	96.3	87.6	5.65	0.14
No. Days Pregnant on July 19, d[f]	82.1	75.7	78.8	5.13	0.71

Abbreviations: Trt=Treatment; BT= Breed type. Mean cow BW 1271.57 +/- 132.98 lb.
Experiment dates: D1 = Dec. 19, 2006; D 43 = Jan. 31, 2007; D 90 = Mar. 19, 2007; D 190 = June 27, 2007.

[a,b,c] Means followed by different letters differ (P < 0.05).

[d]Means adjusted for covariables when appropriate: cow initial BW; age of cow (AOD); cow breed type (Brangus, Braford, ¾ Angus1/4Brahman); calf birthweight; calf BW at d 90; calf age at d 90; calf breed type.

[e]Cow BW and cow ADG affected by calf breed type.
[f]Cow breeding season was from March 26 to June 13, 2007 (79 days).

Table 2. Cow Body Condition Scores, Rib and Rump Ultrasound Fat (USF) Thickness for Cows fed hay, hay with protein tubs, or hay with 0.5% BW whole cottonseed for 90 d in winter. (BCS Scores: 1 = Emaciated; 5= Normal flesh; 9= Obese).

Item	Trt 1 Hay	Trt 2 Hay+Prot Tub	Trt 3 0.5% BW WCS	SE	Trt *P* <
No Cows (13 / Rep)	26	26	26		
Initial Cow BCS	4.92	4.84	4.89	0.10	0.87
D 90 Cow BCS	5.11b	4.99b	5.45a	0.12	0.02
Change BCS d1-d90	0.19	0.14	0.55	0.13	0.38
D 212 Cow BCS	5.24	5.18	5.34	0.11	0.12
Change BCS d90-d212	0.12	0.19	-0.11	0.14	0.42
Change BCS d1-d212	0.32	0.34	0.45	0.10	0.65
D 1 US Rib fat, cm	0.53	0.56	0.54	0.06	0.96
D 1 US Rump fat, cm	0.32	0.34	0.32	0.06	0.96
D 90 US Rib fat, cm	0.37	0.35	0.39	0.05	0.81
D 90 US Rump fat, cm	0.32	0.25	0.30	0.05	0.60
D1-d90Change rib fat	-0.16	-0.21	-0.15	0.04	0.57
D1-d90 Change rump fat	-0.00	-0.09	-0.02	0.04	0.37
D212 US Rib fat, cm	0.44	0.46	0.48	0.10	0.97
D212 US Rump fat, cm	0.34	0.40	0.33	0.12	0.19
D90-d212 Change rib fat	0.09	0.06	0.06	0.06	0.83
D90-d212Change rump fat	0.03	0.18	0.06	0.10	0.37
D1-d212 Change rib fat	-0.07	-0.09	-0.08	0.05	0.96
D1-d212 Change rump fat	0.03	0.09	0.05	0.08	0.87

[a,b]Means followed by different letters, differ ($P < 0.05$). Means adjusted for covariables: Cow initial BW; age of cow (AOD).

Table 3. Calf gain performance when fed hay, hay with protein tubs, or hay with 0.5% BW whole cottonseed for 90 d in winter.

Item	Trt 1 Hay	Trt 2 Hay + Protein Tub	Trt 3 Hay + 0.5% BW WCS	SE	Trt P <
No Calves (2 Reps)	25	24	26		
Calf Birthweight, lb	83.5	90.0	88.0	2.43	0.15
Calf age on D90, days	43.7	46.6	51.0		
D 90 Calf BW, lb	194.6	190.1	200.4	6.23	0.16
D1-d 90 Calf ADG, lb	2.66	2.56	2.56	0.11	0.73
D 190 Calf BW, lb	428.2a	418.4[ab]	406.5[b]	7.30	0.11
D190 Calf ADG, lb	2.32[a]	2.25 [ab]	2.18 [b]	0.05	0.14
D 90-d190, ADG, lb	2.33[a]	2.24 [ab]	2.11 [b]	0.08	0.11
D212 Calf BW, lb	480.1 **[a]**	469.2 [ab]	451.2 [b]	8.04	0.05
D1-d 212 Calf ADG, lb	2.33 [a]	2.26 [ab]	2.16 [b]	0.05	0.07
D 90-d 212 Calf ADG, lb	2.33 **[a]**	2.25 [ab]	2.10 [b]	0.07	0.05
Calf Weaning wt., lb[c]	563.9	575.0	562.8	7.54	0.65
Calf 205-d Adj Wt, lb[d]	523.3	530.5	520.2	9.63	0.73
ADG Birth to Wean, lb	2.14	2.15	2.12	0.05	0.65
ADG D90 to Wean, lb	2.06	2.13	2.06	0.21	0.65

[a,b] Means followed by different letters, differ (P < 0.05).

Means adjusted for covariables: cow initial BW; age of cow (AOD); calf birthweight; calf BW at d 90; calf age at d 90.

[c]Calf weaning wt. adj. for covariables: Calf breed type, calf BW at d 90, calf age. Calf weaning weights (lb) were different (P< 0.01) for cow breed types: Brangus, Braford, ¾ AN1/4Brahman, respectively, 587[a], 582[a], 532[b], SE 7.51.

[d]Calf 205-d Adj.wean wt adj. for covariables: Calf breed type, calf BW at d 90, calf age; calf 205-d adj. weights were different (P< 0.01) for cow breed types: Brangus, Braford, ¾ AN1/4Brahman, respectively, 542[a], 538[a], 494[b], SE 8.39.

Table 4. Hay disappearance and supplement intake for cows fed hay, hay with Sweetlix protein tubs[a] , or hay with 0.5% BW whole cottonseed for 90 d in winter (As-fed basis).

Item	Rep	Trt 1 HayOnly	Trt 2 Hay	Trt 2 Tub Prot[a]	Trt 3 Hay	Trt 3 0.5% WCS	HayStatistics *P* <
Day 43	1	54.2	47.4	0.805	41.6	6.538	
	2	45.5	51.5	1.163	43.2	6.538	
Mean		**49.9**	**49.4**	**0.984**	**42.4**	**6.538**	**0.254**
Day 91	1	42.2	35.9	0.415	33.4	6.538	
	2	35.9	40.5	0.764	34.8	6.538	
Mean		**39.1**	**38.2**	**0.590**	**34.1**	**6.538**	**0.386**

[a]Based on 1000 lb cow, cattle should consume 1 to 2 lb of block/head daily (Sweetlix® recommendation).

Table 5. Chemical analyses of round bale hay and whole cottonseed (WCS) fed to cows Dec.19, 2006—March19, 2007, 90 days.

Item	DM	CP	ADF	NDF	NFC	EE	TDN, %
	-----------------------------%, DM basis ---------------------------						
Hay[a]	92.1	13.1	38.9	71.4	11.1	3.0	55.2
WCS[b]	91.8	24.1	46.0	60.2	----	15.7	69.6

[a]Mean of analyses conducted on hay samples from 12 round bales. Each sample analyzed was the composite of three core samples (one taken from end and 2 at 45 degree angles from sides of each hay bale) on four sampling dates during the 90-d feeding experiment, using an electric drill and a 24 inch Penn State hay probe.

[b]Nutrient composition of whole cotton seed fed to beef cows. During the 90-d feeding experiment, Individual WCS samples (n=10) were collected and analyzed by Dairy One, Ithaca, NY.

Table 6. Nutrient composition of Sweetlix® 24% Poured Block[ab] fed to beef cows. Samples analyzed by Dairy One, Ithaca, NY (Data presented on DM basis. Protein Sup. in poured tubs, sold as 24% CP, As-fed basis).

Sample ⇨	**859**	**860**	**861**	**862**	**863**	**864**	**865**	**866**	Mean
DM, %	83.1	84.5	84.9	84.4	82.8	81.8	80.7	80.0	**82.77**
CP, %	30.4	30.6	30.9	30.2	31.5	30.4	30.5	30.8	**30.66**
ADF, %	5.0	5.1	6.4	8.2	5.3	7.6	6.4	3.2	**5.9**
NDF, %	18.9	11.3	8.5	12.4	10.7	10.2	8.6	9.6	**11.28**
EE, %	0.8	0.8	0.3	0.6	1.7	1.4	1.3	1.1	**1.0**
Minerals									
Ca , %	1.25	1.19		1.00					**1.15**
P, %	0.18	0.20		0.09					**0.16**
Mg, %	4.88	4.85		4.76					**4.83**
K, %	3.47	3.49		3.59					**3.52**
Na %	1.45	1.46		1.29					**1.4**
Fe, ppm	764	771		728					**754.3**
Zn, ppm	217	230		199					**215.3**
Cu, ppm	51	53		48					**50.7**
Mn, ppm	219	229		185					**211.0**
Mo, ppm	1.3	1.5		1.4					**1.4**

[a]Commercial product: Sweetlix®, PO Box 8500, Mankato, MN 56002. Manufacturer guaranteed analysis: CP (min) 24.0%, (not more than 18% equivalent CP from non-protein nitrogen); crude fat (Min) 5.0%; crude fiber (Min) 6.0%; Ca (Min) 0.50%; Ca (Max) 1.0%; P (Min) 0.08%; salt (Min) 2.5%; salt (Max) 3.00%; Mg (Min) 3.0%; K (Min) 2.0%; Se (Min) 3.4 ppm; Vitamin A (Min) 15,000 IU/lb; Vitamin D-3 3750 IU/lb; Vitamin E 3.75 IU/lb.

[b]Based on 1000 lb cow, cattle should consume 1 to 2 lb of block/cow daily (Sweetlix® label recomendation).