Observations of Milk Production and Weight Change in Beef Cows Fed Extruded Cottonseed

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ABSTRACT

The evaluation of three protein supplements was the focus of this study conducted during the summer of 1997. Cottonseed meal (CSM), extruded whole cottonseed (EWC), and extruded cull cottonseed (ECC) were utilized as protein supplements to lactating cows fed red top cane stubble hay under dry lot conditions. Purebred Angus cow-calf pairs (n = 24) were randomly sorted into two groups. The animals in each group received each of the same three protein supplements over a six-week period during late lactation (average of 142 to 186 days postpartum). Milk yield and cow and calf weight was measured at the beginning of the trial and at the end of each interval (approximately 2 weeks). The milk was analyzed for crude protein and milk fat using the Kjeldahl procedure and Babcock milk fat test, respectively. Crude protein level in CSM was much higher (41.0%) than EWC (21.8%) or ECC (22.8%), while crude fat levels of CSM (2.4%) were much lower than EWC (20.4%) and ECC (21.7%). An apparent advantage was seen for 18-hour milk yield with ECC (8.1 lb) or EWC (8.2 lb) over CSM (7.3 lb) as the protein supplement. There was also an apparent difference on cow weight change where the cows fed CSM gained more weight (0.88 lb/day) than those fed the ECC (−0.36 lb/day) or EWC (−0.42 lb/day). There were no apparent differences for calf weight gain, milk crude protein or milk fat across the three protein supplements. Moderate correlations were seen between milk yield and calf growth; however, correlations between cow weight change and milk yield were not strong.

KEYWORDS: Extruded cottonseed, Milk production, Beef cows, Weight gain

Milk yield in beef cattle has a strong impact on calf growth as well as the cow's future reproductive performance. Cattle breeders have placed emphasis on milk yield through the use of milk EPDs (Expected Progeny Differences) when selecting registered sires. The milk EPD of a bull expresses how many additional pounds of calf at weaning are expected due to his daughter's level of milk production compared to that of daughters of the average bull in the breed. Females with higher milk EPD's will generally produce more milk than their lower milk EPD counterparts. It is also believed that females producing large amounts of milk will not be as reproductively efficient as lower milking cows when feed resources are limited due to loss of body fat reserves. For many years,

Paper number T-5-386 of the College of Agricultural Sciences and Natural Resources, Texas Tech University.

Table 1. Initial means and standard deviations for weight and milk traits among cows.

	Cow wt (lb)	Calf wt (lb)	Day of lactation	Milk EPD
Group 1	1234 ± 279	363 ± 79	159 ± 18	6 ± 6
Group 2	1300 ± 356	382 ± 78	156 ± 25	9 ± 5

emphasis has been placed on the production of beef calves with high weaning and yearling weights, resulting in cows with greater mature weights. Many breeds have also stressed emphasis for higher milk production. Several studies (Diaz et al., 1992; Marston et al., 1992; Mallinckrodt et al., 1993; Marshall et al., 1993) have verified that milk EPD indicates actual milk production. As a result, these changes in commercial cows have been achieved through selection, as well as through heterosis in crossbreeding systems. The effects of selection for increased mature weight and milk yield on reproductive performance in beef cows still is not completely understood (Fiss et al., 1988).

One important factor that can affect milk yield and composition as well as cow and calf weight gain is nutrition. It is necessary that cattle receive proper nutrition in order to achieve optimal performance. Nutritional values vary among different feedstuffs, and among feeds subjected to various processing methods. Extrusion is a processing technique that uses heat and pressure to modify feeds. Extruded feed stuffs are believed to have increased feeding values compared to non-extruded feeds due to the fact that they are more highly digestible. Additionally, they are thought to have an increased feed-grade fat source. According to Hancock (1992), this process involving both heat and pressure also eliminates many anti-nutritional factors, antigenic components, and toxicants in a variety of feedstuffs. Feeding of extruded cottonseed to lactating beef cows has not been thoroughly investigated. Therefore, the main focus of this study was to evaluate cottonseed meal and two extruded cottonseed products as protein supplements in a beef cow herd during late lactation to determine their effects on milk production and weight change.

EXPERIMENTAL PROCEDURES

Lactating Angus cows (n = 24) were used to study the effects of three cottonseed-based protein supplements on cow and calf weight change, and milk yield and composition. These females ranged from two to eight years of age with milk EPDs ranging from −5 to 15 (average of 7). This trial began on July 18, 1997 and concluded on August 27, 1997. The means and variation in initial cow weight, initial calf weight, days of lactation and milk EPD are shown in Table 1. These cows were milked four times at 12 to 14 day intervals. The cows were randomly split into two separate groups (12 cows in each), which allowed the feeding of two different protein supplements at one time. Two protein sources were evaluated within each of the three time periods. Each protein source was evaluated in each group of cows, during two different time periods. Pen space limitations prevented three groups of cows being used in a traditional Latin Square design.

When the trial initiated, the cows were also involved in a USDA-CSREES cooperative research project (S-277) dealing with milk yield, and thus had been milked twice earlier in this lactation. The calves were separated from the cows approximately 16-20 hours prior to milking and weighed at approximately 8:00 A.M on milk collection days. Each cow was injected intramuscularly with 1 ml of ace promizine and 2 ml of oxytocin approximately 15 minutes before milking to stimulate milk letdown. Each cow was milked

Table 2. Nutritional Aspects of Three Evaluated Protein Supplements and Hay.

Feedstuff	CP[1] (%)	EE[2] (%)
Cottonseed Meal	41.00[3]	2.41
Extruded Whole Cottonseed	21.79	20.41
Extruded Cull Cottonseed	22.83	21.67
Red Top Cane Stubble	7.50	.70

[1] Crude Protein
[2] Ether Extract
[3] Guaranteed at 41%, but not independently verified

in a squeeze chute with only her head restricted. Cow number and weight were recorded at time of milking. The udder of each cow was washed before being milked. Milk was collected in a plastic bucket under vacuum with a portable milking machine and weighed. Two, 30-ml samples were collected and put on ice to be later analyzed for protein and milk fat. The bucket was washed with water and reassembled between cows.

The milk samples collected were taken to the Food Technology Laboratory (Texas Tech University) to be analyzed for protein and milk fat. All of the samples used to determine protein percent were run in duplicate using the Kjeldahl procedure. Milk fat was measured using the Babcock milk fat test. Extra samples were collected during the final milking and sent to a commercial dairy lab. They were analyzed for protein and milk fat using infrared (MS50/Foss) technology. This external lab work was conducted in order to verify the accuracy of the previous lab work conducted during the project.

The cattle used in this trial were housed in dirt-floor pens (130 ft × 190 ft) at the Texas Tech Beef Center, fed once a day and had free access to water. During the first period of the trial, July 19, 1997-August 1, 1997, group 1 received extruded whole cottonseed (EWC) while group 2 was fed cottonseed meal (CSM). In the second period of the trial, August 2, 1997-August 13, 1997, group 1 was fed CSM and group 2 fed extruded cull cottonseed (ECC). During the third period, August 14, 1997-August 27, 1997, group 1 received ECC, and group 2 was fed EWC. Cows were in each period for 12-14 days. Each morning cattle were fed the designated protein supplement, which was either 3.0 lb/hd/d of CSM, or 6.0 lb/hd/d of either EWC or ECC. All cows were offered 35 lb/hd/d of red top cane stubble hay, which was chopped into approximately six-inch pieces using a Hesston BP 25 portable grinder. The analysis for crude protein and ether extract on the hay and all three supplements are listed in Table 2.

Yield, crude protein and fat content of milk, cow weight and weight change, and calf weight and weight change were analyzed. All traits were analyzed as repeated measure traits of the cows. Due to unbalance of data comparing protein supplement and time period, no formal statistical analyses are presented. Mean and standard errors are reported for traits of interest. Linear correlations between milk yield and cow weight change and calf weight change were calculated using SAS (1989).

RESULTS AND DISCUSSION

Preliminary analyses were conducted to determine whether time of milking (16 to 20 hour range) affected milk yield. Regressions of milk yield on time were not significant for any milk collection, indicating that all cows had completely filled udders and that order of milking was not important. Means for milk yield, crude protein, and butterfat

Table 3. Means and standard errors for milk characteristics.

Treatment	N	Yield (lb)	CP[1] (%)	BF[2] (%)
CSM[3]	24	7.3 ± .40	2.9 ± .05	2.8 ± .15
ECC[4]	24	8.1 ± .40	2.9 ± .05	2.9 ± .16
EWC[5]	24	8.2 ± .35	3.0 ± .04	3.0 ± .14

[1]Crude protein
[2]Butter fat
[3]Cottonseed meal
[4]Extruded cull cottonseed
[5]Extruded whole cottonseed

Table 4: Means and standard errors for weight change in cows and calves per protein supplement.

Treatment	# Days Fed	Cows (lb)	Calves (lb)
CSM[1]	26	22.7 ± 14.21	25.6 ± 4.38
ECC[2]	26	− 9.3 ± 14.37	22.7 ± 4.42
EWC[3]	28	− 11.9 ± 13.22	26.2 ± 4.07

[1]CSM = cottonseed meal
[2]ECC = extruded cull cottonseed
[3]ECC = extruded whole cottonseed

across treatments are listed in Table 3. When the cows in this trial were fed cottonseed meal (CSM) compared to the extruded products, milk yield was apparently decreased. Cows that were fed extruded whole cottonseed (EWC) and extruded cull cottonseed (ECC) produced an average of 3.73 kg and 3.68 kg, respectively, while cows fed CSM produced 3.32 kg of milk. There was no apparent difference between the two extruded supplements for milk yield. There were also no apparent differences in crude protein or fat content of milk among the three protein supplements. This is somewhat surprising because the extruded cottonseed supplements had much higher levels of fat than the CSM. The cows fed the CSM gained weight during the feeding trial (0.88 lb/day), while cows fed ECC and EWC lost 0.36 and 0.43 lb/day, respectively. All of the hay offered to the cows was consumed (35 lb/day/cow). Sanders (1998) concluded that the effects of extrusion had negative effects on ruminal digestion of dry matter and ruminal nitrogen disappearance but positive effects were associated with total dry matter digestibility in feedlot steers. This may explain cow weight loss in conjunction with increased nutritional demand for higher milk production. Sanders (1998) also reported that extruded cottonseed in the diet of growing beef steers did not alter volatile fatty acid profile in the rumen compared to cottonseed meal. There were no apparent differences among calf weights across the three protein supplements given to their dams. Calves in all three treatments gained weight throughout the trial.

Calf weights are usually expected to increase as milk production increases. In this case, the extruded products apparently increased milk production, but corresponding increases in calf weight gain were not seen. Moderate relationships were observed for overall milk production and calf weight gain. Results on cow and calf weight gains are summarized in Table 4. Milk yield at day 156 of lactation and cow weight change from days 142 to 156 of lactation had a correlation of -0.41 ($P = 0.04$). This was the only period that milk yield and cow weight change were significantly related. Additionally,