were produced in the steer trial of this study. Clinical signs of nitrate toxicity become apparent at methemoglobin concentrations of 30 to 40 percent, and death occurs at methemoglobin concentrations of about 80 to 90 percent (Van Gelder, 1976). Mean methemoglobin concentrations of about 20 to 50 percent at 4 to 7 hours after feeding the high-nitrate hay to the steers and the calculated nitrate intakes indicate that the steers did receive a nitrate challenge. Reasons for the apparent discrepancy in these results and those of Grebing (1974 and 1976) are not understood.

Literature Cited

Grebing, Stan. 1974 and 1976. Personal correspondence.
Leahy, Thomas and Roger Smith. 1960. Clinical Chem. 6:148.
Lewis, D. 1951. Biochem. J. 48:175.
Sapiro, M. L. et al. 1949. Onderstepoort J. Vet. Sci. Anim. Ind. 22:357.
Streeter, C. L. et al. 1981. Okla. Agr. Exp. Sta. Res. Rep. MP-108:101.
Van Gelder, Gary A. 1976. Clinical & Diagnostic Vet. Toxicology. p. 109.

Effect of Breed of the Calf on the Response to Assembly Stress and Subsequent Postassembly Performance

W. A. Phillips and R. R. Frahm

Story in Brief

Steer calves representing four crossbred groups were used to determine the effect of calf breed on the amount of weight lost during assembly and the subsequent postassembly performance. All breed groups were raised under the same environmental and managerial conditions and subjected to two periods of fasting and one period of refeeding to simulate the stress of assembly and transit. Calf breed had no effect on the amount of weight lost during the first period of fasting in the assembly process. There were differences among breeds in the amount of weight regained during a refeeding period following the first fast and in the amount of weight lost during the second period of fasting, which simulated

USDA, Agricultural Research Service, Southern Region in cooperation with the Oklahoma Agricultural Experiment Station.

the transit phase. Postassembly feed consumption and rate of gain was not significantly affected by calf breed, but the cost of a pound of gain over the weaning weight increased as the percentage of Brahman breeding increased. Thus, it appears that calf breed can affect the amount of weight lost during assembly as well as the cost of gain during the early feeding period.

Introduction

During the past 5 years the USDA in cooperation with various state experiment stations has been conducting research to reduce the losses in beef calves due to the stresses imposed at the points of assembly and as the result of transit. The farm of origin from which the calves were purchased has consistently had a significant impact on the performance and health of stocker calves after they have been exposed to the stressors found in the assembly and transit system, which moves beef calves from the cow-calf farms to the next production point. It is logical to anticipate that the farm of origin would be important because it is a broad classification taking in the breed and age of the calf, prior nutrition level and parasite exposure, just to list a few. Of all these components, the genetic variation (breed) could be one of the most important factors. To date, no observations have been reported on calves of different definable breeds born and raised at the same farm of origin.

It is important to identify factors which influence how much weight is lost during assembly and how quickly the weight can be regained. The arrival weight of the calf at the final destination is much less (4-10 percent) than the amount purchased. This loss is due to periods of fasting and refeeding associated with assembly and transit. Until the calf regains the lost weight, it is not a productive unit. Thus, the amount of weight lost should be reduced, or the recovery time for the lost weight should be shortened. The objective of this experiment was to determine the effect of calf breed on feed consumption and weight changes during and after exposure to the stressors associated with assembly and transit.

Materials and Methods

Ninety-two crossbred steer calves, representing five different definable breed groups, were born and raised under the same management and environmental conditions at the Southwestern Livestock and Forage Research Station, El Reno, Oklahoma. The breed groups consisted of either 0, 25 or 50 percent Brahman breeding. Hereford and Angus dams served as the foundation herd. The various percentages of Brahman breeding were incorporated through the use of purebred and crossbred Brahman sires. The resulting calves were classified as ½ Hereford ½ Angus (HA), ¼ Brahman ¼ Hereford ½ Angus (BA), ¼ Brahman ¼ Angus ½ Hereford (BH), ½ Brahman ½ Hereford or ½ Brahman ½ Angus. Due to the small number of calves in the last two groups, these calves were combined to form a 50 percent Brahman breed group (B). Thus, there were only four breed groups.

Calves were weaned and weighed at an average age of 205 days. All calves were commingled in a 12 ft by 112 ft pen without feed or water for the first 24 hr to simulate the stress which would be associated with the auction barn phase of the normal assembly process. After the initial fast the calves were weighed, moved to a larger pen (200 x 225 ft) and allowed access to medium quality hay and water for the next 72 hr to simulate the order-buyer barn phase of the assembly process. This phase was followed by weighing each calf and crowding them into a 12 ft x 112 ft pen without feed and water for 24 hr to simulate the fasting and restraint associated with transit. On the following day the calves were moved a short distance and placed in 25 ft x 50 ft dirt-surface pens. Six calves from the same breed were allotted to each pen based on weaning weight. Four pens, each containing one breed group, were used per replicate. Animal numbers were not equal, so only three full replicates could be constructed. The remaining calves formed an incomplete replicate. There were 22 HA, 34 BA, 17 BH and 19 B calves.

The same ration was fed daily to all calves for 28 days and contained 53.7 percent corn, 35.2 percent cottonseed hulls, 7.9 percent soybean meal, .9 percent dry molasses, .3 percent urea, .6 percent calcium sulfate, .1 percent calcium carbonate and 1.3 percent potassium chloride. The ration allowance for the first day was 5 lb per head. That amount was increased at the rate of 2 lb per head per day until refusals were noted. Body weights were determined at weekly intervals just prior to the morning feeding. Feed consumption was also determined weekly for each pen. Each calf was observed daily for clinical symptoms of respiratory disease or other clinical problems. Sick calves were treated with antibiotics and then returned to the original pen. At the termination of the study, the calves were fasted for 18 hr then weighed.

The data from the three complete replications were analyzed as a randomized block design. No differences due to replication were noted, so the complete data was then analyzed as a one-factor experiment to determine differences among the four crossbred groups.

Results and Discussion

The weight at weaning and the changes in body weight during the assembly process are shown in Table 1. The average weaning weight was 505 lb, with the B calves being the heaviest and the BH calves being the lightest at weaning. Calves lost an average of 43.2 lb (8.7 percent) during the initial 24-hr fast. There was no difference in the amount of weight lost during this period due to the breed of the

Table 1. The effect of calf breed on weight changes during fasting and refeeding

Weight and weight changes at each assembly point	Breed of calf[a]				
	HA	BA	BH	B	Mean
Weaning weight, lb	486	515	468	542	503
After 24-hr fast; lb lost	41.2	43.6	40.6	47.0	43.2
% of wwt[b]	91.4	91.5	91.0	91.3	91.3
After 72-hr refeed; lb gained	31.0[c]	29.3[c]	21.2[d]	29.8[c]	28.1
% of wwt	98.1[c]	97.2[cd]	95.72[d]	96.8[cd]	97.0
After 2nd fast; lb lost	28.0	27.2	25.11	30.4	27.6
% of wwt	92.2[c]	91.9[c]	90.2[d]	91.2[cd]	91.5

[a] HA = 1/2 Hereford 1/2 Angus, BA = 1/4 Brahman 1/4 Hereford 1/2 Angus. BH = 1/4 Brahman 1/4 Angus 1/2 Hereford, and B = 1/2 Brahman 1/2 Hereford or 1/2 Brahman and 1/2 Angus.

[b] wwt = weaning weight.

[c,d]Means in the same row with different superscripts differ ($P<.05$).

calf when expressed as pounds lost or as a percentage of the weaning weight. There was, however, a significant difference in the amount of weight gained during the subsequent 72-hr refeeding period. Calves within the HA, BA and B groups gained 29.9 lb during this period, which was 68 percent of the 44 lb of weight lost during the previous 24-hr fast. After the refeeding period these calves weighed 97.4 percent of their weaning weight. BA calves gained only 21.2 lb during the refeeding period, which was 8.7 lb less than the other three groups. Although the calves and dams were reared in a research environment, the weaning procedure seemed stressful as judged by observations of the calves postweaning. The calves walked around the perimeter of the pens during both fasting and refeeding phases, which is characteristic of the stress of separation from the dam. It was approximately 48 hr after hay and water were afforded during refeeding before the majority of calves began to eat hay. The difference in the amount of weight gained during the refeeding period probably reflects a difference in the amount of hay and water consumed or the time at which the calves began to consume hay.

The importance of regaining as much of the weaning weight as possible during the refeeding period is illustrated in Table 1. After the refeeding period a second period of fasting was imposed to simulate the transit phase. The HA, BA and B groups gained more weight during the refeeding period but lost more weight during the second fasting period. The amount of weight lost by the calves in these three groups was 28 lb, which was 1.7 lb less than the amount previously gained. Thus, these calves entered the conditioning lot at 91.8 percent of their weaning weight. Although the BH calves lost less weight during the second fasting period, they had already lost 8.7 lb more than the other calves. After regaining 21.2 lb during the refeeding period, they lost 25.1 lb during the second fast; thus, an additional 3.9 lb were lost over and above the amount regained. As a result, these calves entered the conditioning lot at 90.2 percent of their weaning weight. The BH calves tended to be slower in regaining previously lost weight during the refeeding phase. Although the calves were not actually transported, the average amount of weight lost during this period was 5.6 percent of the prefast body weight, which was comparable to previous observations of calves transported 850 miles by a commercial carrier (Phillips et al., 1981). No differences were noted in ration consumption among the different breed groups (Table 2). The calves readily consumed the ration provided. As described previously, the initial

Table 2. The effect of the calf breed on the amount of ration consumed during each week

	Breed of calf[a]				
Time period	HA	BA	BH	B	Mean
Week 1	9.50[b]	9.50	9.48	9.48	9.50
Week 2	13.24	13.86	13.64	13.29	13.56
Week 3	17.26	18.02	17.90	19.60	18.10
Week 4	20.41	20.60	20.66	22.70	20.96
Mean	15.10	15.49	15.42	16.27	15.52

[a] HA = 1/2 Hereford 1/2 Angus, BA = 1/4 Brahman 1/4 Hereford 1/2 Angus, BH = 1/4 Brahman 1/4 Angus 1/2 Hereford and B = 1/2 Brahman 1/2 Hereford and 1/2 Brahman 1/2 Angus.

[b] Pounds of 90% dry matter ration per head per day.

allotment of ration was 5 lb per calf on day 1. The amount was then increased at 2 lb increments each day if no refusal was noted. In order to prevent digestive problems, the calves were held at 12 lb of ration per head for 2 days (days 5 and 6) before increasing the amounts provided. As a result, there were no refusals during the first week, and intakes were the same for all pens. As noted in Table 2, ration consumption increased weekly from 9.6 lb per head per day during week 1 to 21.0 lb per head per day during week 4. The average daily ration consumption for the 28-day long experimental period was 15.9 lb per head per day. This level of feed consumption was approximately 1 lb more per day than previously noted for Angus calves, which had been transported 850 miles (Phillips et al., 1981).

The BH calves were the lightest group at weaning and lost more weight during the assembly process (Table 1) than the other three groups, but they consumed as much feed during the 28-day postassembly period as the other three breed groups. Thus, the BH calves consumed more ration as a percentage of their body weight than the other three groups, but this was only significantly greater during weeks 1 and 2. By the fourth week of the postassembly period, ration consumption was 3.9 percent of body weight and similar for all four breed groups.

During the assembly period, the calves appeared to be distressed over the change in surroundings and the absence of the dams. The amount of weight lost during the various phases of fasting was similar to previously observed values when calves were moved through the normal industry channels. Thus it was felt that the stresses found in the normal channels were accurately simulated, but recently published data by Galyean et al. (1981) indicates that the physiological response to fasting alone is different from transit. Transit can have a negative effect on rumen function, which would influence posttransit ration consumption. Subsequent experiments to study these breed groups will employ an actual transit phase.

The amount of weight gained each week and the accumulative weight gain for the 28-day period are shown in Table 3. There were no differences in the amount of weight gained due to the breed of the calf, but large increases were noted during weeks 1 and 2 because the initial weight was a shrunk weight taken at the end of the last assembly fast. The subsequent weights taken 7 and 14 days later

Table 3. The effect of the calf breed on the amount of weight gained each week after assembly

	Breed of calf[a]				
Time period	HA	BA	BH	B	Mean
Week 1	25.3	29.0	32.8	34.5	29.9
Week 2	32.8	33.2	26.3	26.2	30.4
Week 3	20.2	16.8	23.7	22.4	20.1
Week 4	12.2	10.2	10.1	9.9	10.6
Total	90.5	89.2	92.9	93.0	91.0
Adj. weight[b] gain	59.4	54.6	69.1	54.9	58.8

[a] HA = 1/2 Hereford 1/2 Angus, BA = 1/4 Brahman 1/4 Hereford 1/2 Angus, BH = 1/4 Brahman 1/4 Angus 1/2 Hereford and B = 1/2 Brahman 1/2 Hereford or 1/2 Brahman 1/2 Angus.

[b] Adjusted weight gain was corrected for gut fill by fasting the calves overnight before weighing.

were full weight. Thus a large part of these weight gains are due to replacing the gut fill. Approximately 30 lb were gained each week for the first 2 weeks, then 20 and 10 lb per head per week for the last 2 weeks. The average increase in weight for the 28-day period was 91 lb. Using data from Table 1, the net amount of weight lost after weaning can be calculated. Subtracting this from the weight gained after assembly yielded a net gain of 48.5 lb over weaning weight or 1.73 lb of additional gain per day.

Adjusted weight gains are also shown in Table 3. These gains are the difference between the initial postassembly weight and a shrunk weight taken at the end of the 28-day period. This should account for any gut fill differences and be a more accurate reflection of body mass changes during the 28-day experiment. HA, BA, and B groups have similar adjusted weight gains. Although the BH appeared to have gained more body mass during the 28-day postassembly period, it was not significantly greater than the other three groups. The BH group had already lost almost 9 lb more than the other three groups during assembly. So the net gain over weaning was similar for all groups.

Calculated from the weight change data in Tables 1 and 3 and the feed consumption data from Table 2, the net gain over weaning weight and the cost per pound of this gain are presented for each breed group in Table 4. A price of $135 per ton was established as the cost of the postassembly ration, and the total feed cost is presented in Table 4. The cost of the feed consumed during the 28-day period was charged against the net weight gain (gain above weaning weight). The HA calves had a cost of gain of 54.57¢ per lb of gain over weaning weight, which was 6.79¢ to 13.14¢ less than the other groups. This difference was due to a slightly greater rate of net gain and lower feed consumption. These differences were not statistically significant, but the number of observations was small. Additional collection of data on these breed groups over the next 3 years will increase

Table 4. The effect of the calf breed on net weight gain and cost of gain

Item	Breed of calf[a]			
	HA	BA	BH	B
Total amount of feed consumed, lb	423	434	432	455
Feed cost at $135 ton[b]	$28.54	$29.27	$29.15	$30.74
Gain for 28 day, lb	90.5	89.2	92.9	93.0
Total weight lost during assembly, lb	38.2	41.5	44.5	47.6
Net gain over weaning weight, lb	52.3	47.7	48.4	45.4
Cost per lb of gain over weaning weight	54.57¢	61.36¢	64.21¢	67.71¢

[a] HA = 1/2 Hereford 1/2 Angus, BA = 1/4 Brahman 1/4 Hereford 1/2 Angus, BH = 1/4 Brahman 1/4 Angus 1/2 Hereford and B = 1/2 Brahman 1/2 Hereford or 1/2 Brahman 1/2 Angus.

[b] Cost of feed was calculated from ingredient prices at the time of the trial (Oct. 1981) and includes a 15% markup.

the number of observations and help to determine if the trends noted in this report are consistent over years.

Literature Cited

Galyean, M. L., 1981. J. Anim. Sci. 53:7.
Phillips, W. A. and J. B. McLaren. 1981. Okla. Exp. Sta. Res. Rep. MP-108:108.

Adaptation of Stocker Calves to NPN as the Result of Consuming Wheat Forage

W. A. Phillips

Story in Brief

Twenty-four heifer calves were divided into two groups. A control group was fed wheat straw, soybean meal and corn, and another group was fed wheat forage. Consumption of wheat forage resulted in significantly higher ruminal ammonia and nonprotein nitrogen (NPN) concentrations than found in the control group. A change in the ruminal metabolism of the forage nitrogen was noted 30 days after consumption of forage began. Concentrations of ammonia and NPN in the rumen decreased, and plasma protein concentration increased. Although the wheat forage group appeared to be going through an adaptation phase to NPN while grazing, the utilization of a urea supplement fed to both groups following the grazing phase was not different from that of the unadapted control group. The consumption of wheat forage during March and April did not increase the utilization of urea following the grazing period, but there may be another form of NPN to which adaptation had occurred.

Introduction

Wheat pasture has been used extensively in the southern plains area as a high quality forage for young ruminants from November to March and even as late as May if a grain crop is not harvested. The protein content of wheat forage will vary within the grazing period and between different years. The protein content as a percentage of the dry matter has been reported to range from 25 to 32 percent,

USDA, Agricultural Research Service, Southern Region, in cooperation with the Oklahoma Agricultural Experiment Station.