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Introduction

Beef cattle production entails the conversion of plant resources not normally considered as part of the food chain for humans into a food resource that partially fulfills human dietary needs. Traditionally, the beef industry has been segregated into production components, each having its own marketing endpoint. The cow/calf component of the industry produces progeny for introduction into the food chain conversion process. Energy and protein requirements of the commercial cow herd should be fulfilled as much as possible through direct harvest of forages by the animals. Within the U.S., a wide range of forage production environments exist.

Commercial producers have the flexibility to identify breeds or breed crosses to be used as producing females and to identify sire breed or breed crosses to mate with these cows. Previous research at MARC has demonstrated variation among and within breeds for traits affecting weight of calf produced at weaning. Cows representative of breeds with greater genetic potential for growth and lactation yield have been shown to produce calves that are heavier at weaning. Additional research at MARC has documented a positive relationship between genetic potential for production and energy requirement to maintain body weight of the cow. Differences in energy required to sustain the producing female suggest that breeds or breed crosses can be identified that are more effective in the conversion of forage resources into amarketable product. Earlier work conducted at MARC indicated that breed crosses more moderate in growth potential and lactation yield, were more effective in preweaning weight production of calves. The objective of the study was to determine if differences exist among breeds of beef cattle in the efficiency of converting food energy to weight of calf at weaning.

Procedures

In 1986, 16 pregnant multiparous cows from Angus, Braunvieh, Charolais, Gelbvieh, Hereford, Limousin, Red Poll, Pinzgauer, and Simmental cows that were 5 yr or older were assigned to the study. Four cows within each breed were assigned to one of four energy availability levels: 130, 170, 210 or 250 Kcal of metabolizable energy (ME) per metabolic body size ($wt.^{75}$) during nonlactating periods or during lactation fed at the rate of 170, 210, 240, or 290 Kcal ME/$wt.^{75}$. Individual animals remained at the assigned levels throughout the test period. Daily feed allotments of individual cows (Table 1) were based on the weight of the cow (measured approximately at the seventh month of gestation) at the time of the cow's assignment to the study. Cows were individually fed and received their daily allotment in a single feeding. Feed refused by the cows over a seven day period was measured and recorded. Feed consumed by the cow was determined as the difference between the feed provided for a seven day period minus the feed refusal. In mid-March each year all pregnant cows were transported to drylots for calving. Male calves were castrated at birth. Birth weights were recorded for all calves. Cow/calf pairs were returned to the test facility approximately 10-14 days after calving. Upon return to the test facility, lactating cows' feed allotments were increased.

Cows were exposed to sires identified within their respective breeds for a 90 day period beginning in mid-June of each year. During the breeding season, cows and calves were separated at approximately 4:00 p.m. daily, the cows were penned by breed, and cows remained in these pens until approximately 7:00 a.m. The 1987 calf crop was weaned in a single group at approximately 200 days. Within the two remaining production years, calves were weaned in two groups with average weaning age and range in age similar to 1987. Following weaning of the calves, daily feed allotments of individual cows were reduced to nonlactation levels.

Weekly feed consumptions for individual cows were summed for the three year test period. Individual calf records were used to adjust the weaning weights of calves to 200 days weaning age. Records of individual cows were summed. Biological efficiency is defined as the ratio of weight of calf weaned relative to the feed consumed by cows weaning calves. The efficiency ratio is an index of the effectiveness of converting feed resource to a marketable product. As used in the present evaluation, it is a measure of that amount of feed energy that was consumed that is available for use by the cow to produce a product. For cows weaning calves, total feed consumption, sum of calf weights weaned, and the ratio of biological efficiency were analyzed to evaluate the effects of breed, level of energy availability, and the breed by level of energy availability upon these traits.

Results

For the traits of interest, the interaction of breed by energy availability was not found to be a significant source of variation. This indicates that the rank among the breeds for these traits would be expected to be the same across all four energy availability levels. Both breed and level of energy availability affected total feed consumption, average weaning weight, total weaning weight for the three year period, and biological efficiency ratio.

Estimates for the traits of interest by level of energy availability are reported in Table 2. Productivity and total weight weaned for the 3 yr period increased as level of energy available to the cow increased. Over the test period, cows receiving the highest feed level produced 30% more weight at weaning than did cows fed at the lowest intake level but only 8% more than at the other two levels. Input, feed consumed during the 3 yr period, was 78% greater for cows receiving the highest feed level, and 65% and 39% for the intermediate groups relative to the feed consumed by the cows assigned to the low feed level. Although cows receiving the lowest quantity of feed produced the lowest product yield for the test period, this group of cattle were 27% more effective in converting feed energy consumed to calf weight than the two highest feed available levels and were 7% more efficient than the 170 $kcal/wt.^{75}$ group.

Breeds of cattle previously characterized as having higher genetic potential for growth tended to be of higher rank for this output component. Comparison of weaning weight yield for the 3 yr period among the breeds indicates some reranking among the breeds for output (Table 3).

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Braunvieh and Charolais had the greatest yield and Hereford the lowest. Input information for the purpose of this report represents feed consumed by cows weaning calves. Charolais, as a breed group, consumed the least amount of feed and Braunvieh and Angus consumed the most. Among straightbred cows producing calves of the same breed, two separate groups could be identified: Red Poll, Braunvieh, Limousin, Pinzgauer, Charolais, and Gelbvieh were the most effective in converting feed energy resources to a marketable product (Table 3). Hereford, Angus and Simmental breeds were less effective in converting the energy resource to weaning weights. Among all breeds, approximately 16% difference was observed between the most and least efficient breeds.

These results indicate that differences in the effectiveness of the conversion of food energy resources to marketable product may be affected by level of food energy availability and choice of breeds. From a feed energy standpoint, the producer needs to be aware of the productivity potential of the forage resources available and the desired level of productivity sought for the cow herd. Harvested energy resources tend in general to have higher cost associated with them. Efforts of the cow/calf producer to improve or maximize total weight weaned through use of supplemental feeding programs or through intentional understocking may result in less than optimum production.

When compared on the basis of pounds of calf weaned per unit of food energy consumed by the producing cow, differences exist among the nine beef breeds evaluated in this study. These breeds have been previously characterized with regard to growth potential and ability for milk production. Using productivity information in conjunction with measures of average production efficiencies for breeds should enable a producer to identify a mating system and the breeds of cattle compatible with the mating system for a defined production environment.

Table 1— Composition of diets (percent of dry matter)

Ground alfalfa	77.5	
Corn	17.5	
Corn silage	5.0	
Metabolizable energy	1.03	Mcal/lb
Crude protein	16%	

Table 2—Effect of level of energy availability upon measures of output and input over three years

	Energy availability (Kcal/wt.$^{.75}$)			
	130	170	210	250
Total feed consumed,(Mcal)	14,391	19,701	23,776	25,739
Three year total weaning wt, lb	873	1,126	1,193	1,237
Efficiency, (lb/Mcal)	.061	.057	.048	.048

Table 3—Effect of breed upon measures of output and input over three years

	Total feed consumed (Mcal)	Three year total weaning wt (lb)	Efficiency (lb/Mcal)
Angus	22,435	1,078	.049
Braunvieh	22,624	1,243	.057
Charolais	17,117	1,243	.055
Gelbvieh	22,036	1,170	.055
Hereford	20,890	985	.048
Limousin	21,786	1,199	.056
Red Poll	20,119	1,130	.058
Pinzgauer	20,186	1,102	.056
Simmental	20,975	1,047	.050