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Energetic Response of Angus and Simmental Crossbred Cows to Low and Moderate Intakes

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Summary

Mature Angus-Hereford (AH; n=15) and Simmental-Hereford (SH; n=16) cows were used to evaluate the effects of adaptation to moderate (adequate to at least maintain body condition) and low (76% of moderate) intakes on feed energy partitioning by cows of different genotypes. Cows were fed individually in drylot for one complete production cycle (12 months). Conventional energy balance techniques and respiration calorimetry were used once during gestation and twice during lactation to evaluate energy utilization. Condition scores differed by .7 units (5.0 vs 4.3; P<.001) between intake levels by the end of the study. Heat production at 195 days of gestation was affected by intake level (P<.001) but not by genotype (P>.20), and there was no interaction between the main effects (GxI P>.20). During lactation measurements, milk energy production did not differ between genotypes and intake levels (P>.15). However, heat productions for AH and SH cows adapted to the low intake were 12% and 7% less than AH and SH adapted to the moderate intake, respectively (GxI P<.05). Additionally, deposition of tissue energy was reduced 20% and 39% by low intake AH and SH cows relative to moderate intake AH and SH cows, respectively (GxI P<.06). The results are interpreted to indicate that genotypes traditionally selected for greater milk production rely more on tissue energy adjustment to support milk production than on reduction of metabolic rate (maintenance).

Key Words: Intake Level, Energy Partitioning, Genotype, Beef Cow

Introduction

It has been estimated that up to 75% of the feed energy needed for beef production is required by the cow-calf segment of the industry. Of that, 70 to 75% is used to cover cow maintenance requirements. As a result, factors affecting cow maintenance requirements can be expected to affect overall beef production efficiency. The following are data describing some aspects of the relationship between genotype and level of intake relative to feed energy utilization by the beef cow. They were derived from a multi-year project designed with the purpose of investigating factors that affect efficiency in cow-calf production.

Materials and Methods

Animals: Energy balance measurements were made on 8 Angus x Hereford (AH) and 8 Simmental x Hereford (SH) cows in year 1 and 7 AH and 8 SH cows in year 2 of this study. They were part of a larger group of cows involved in a production efficiency study that were managed in the same manner except for the energy balance procedures. The cows ranged from 5 to 7 years of age and were the result of a two-way rotational breeding system. Selection of replacements in the herd from which these cows were obtained was random but in adequate numbers within rotational matings to maintain herd size. These breed crosses were selected for this study because they represented genotypes differing in genetic potential for milk production and mature size.

Starting in October of each year, the cows were placed in drylot (approximately 150 days

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of gestation) and assigned to either moderate (197 and 260 kcal ME*kg initial body weight$^{-.75}$*day^{-1} pre- and postcalving, respectively) or low (76% of moderate intake) intakes. The moderate intake was set, based on previous data, at a level expected to at least maintain body condition. The cows were fed individually for 1 year during which body weights and condition scores (1 = emaciated, 9 = obese) were determined monthly. Calves were born in March and April of each year. They were allowed access to the dams twice daily for 1 hour during the feeding period to nurse and were provided with a high roughage creep feed ad libitum at other times. Milk production was measured by weigh-suckle-weigh technique.

Energy Partitioning: In late November (average 195 days of gestation), the cows were brought into the metabolism facilities for a 3-week acclimation and training period. Heat production was then determined by indirect respiration calorimetry using four modified hood calorimeters. The cows were confined to the calorimeters for two consecutive 23-hour periods for fed measurements at their assigned intake levels, during which gaseous exchange was measured. Samples of air entering and leaving the calorimeters were analyzed for oxygen, carbon dioxide and methane content and, together with air flow volume, were used to calculate heat production. The cows were then fasted for 5 days with measurements taken again on days 4 and 5 of the fast.

The cows were returned to the metabolism facility in June and September (average 45 and 150 days of lactation) for a repeat of the procedure with the exception that only fed measurements were made and milk energy output was determined by a combination of weigh-suckle-weigh and machine milking over a period of 5 days. Change in body energy content (tissue energy deposition/mobilization) was calculated as the difference between metabolizable energy (ME) intake and the sum of heat and milk energy.

Diet metabolizability and its adjustment for intake level were determined separately using steers during two 7-day collection periods. Energy partitioning data were statistically analyzed for the effects of genotype, level of intake, their interaction and year, as well as stage of lactation and length of gestation, where appropriate. Least-squares means are reported.

Results and Discussion

Intake levels were fixed and based on body weights measured at the beginning of the trial. Body weights and condition scores changed over time creating differences between moderate and low intake groups of 103 lb (1211 vs 1108 lb.; $P<.001$) and .7 units (5.0 vs. 4.3; $P<.001$), respectively, as determined with the larger group of cows on the production efficiency study. Milk production results (212-day lactation) from the larger group reflected both genotype and intake effects. The SH cows produced 15% more milk than AH at the moderate intake (3892 vs 3375 lb, respectively) but were not significantly different at the low intake (3276 vs 3377 lb., respectively; GxI $P<.05$). Body weight, condition score, and milk production data indicate that genotypes and intakes chosen for this study were adequate to produce the performance differences desired.

Energy partitioning data are presented in Table 1. Heat production by an animal is, to a large degree, the result of using feed energy to perform maintenance functions and, therefore reflects differences in requirements. Heat production at 195 days of gestation was affected by intake level ($P<.001$) as expected but not by genotype ($P>.20$). Additionally, there was no interaction between the main effects (GxI $P>.20$). During lactation measurements, milk energy output also did not differ between genotypes or intake levels. However, not only did intake level affect heat production but it also affected SH differently than AH cows. Heat production by AH cows adapted to the low intake was 12% less than moderate intake AH, whereas it was only 7% less for low intake SH cows compared to moderate SH (GxI $P<.05$; Figure 1). A differential response was also found in deposition of tissue energy with a 20% reduction by AH and a 39% reduction by SH cows at low intake relative to moderate intake AH and SH cows, respectively (GxI $P<.06$).

Table 1. Energy partitioning data[a]

Intake	Low		Moderate	
Genotype	AH	SH	AH	SH
Heat production				
Gestation[c]	123.4	121.6	135.3	137.5
Lactation[d]	136.9	144.1	155.1	154.3
Milk	53.3	50.3	54.6	53.0
Tissue[e]	36.6	29.7	45.7	48.9

[a]kcal*body weight$^{-.75}$*day^{-1}.
[b]AH = Angus x Hereford; SH = Simmental x Hereford.
[c]Intake P<.001.
[d]Genotype x intake P<.05.
[e]Genotype x intake P<.06.

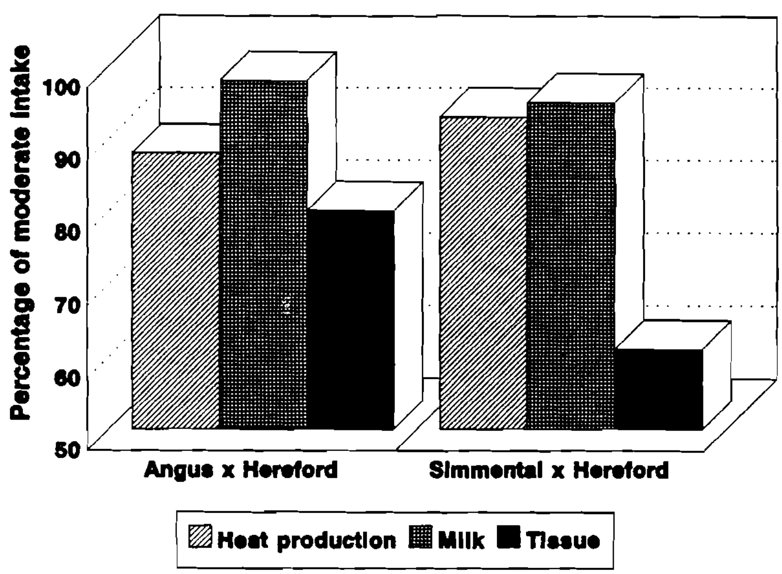

Figure 1. Energy partitioning during lactation (low relative to moderate intake).

Metabolizable energy can be used by the cow for meeting maintenance requirements, development of a fetus, production of milk or energy storage in the body (i.e., fat). If feed energy consumed is inadequate to meet all of the cows needs, adjustments are made in its partitioning among them based on priority and the ability of the animal to alter the efficiency with which energy is used for each function. Although they both maintained milk energy output at the lower intake during metabolism measurements, the AH cows did so by reducing heat production twice as much but tissue energy deposition half as much as the SH cows. The practical significance of this is that any reduction in maintenance requirements represents a true savings of feed energy, and potential improvement in production efficiency, whereas tissue energy removed or not deposited will need to be replaced at some point in the future to maintain body condition and reproductive performance. It would appear that genotypes traditionally selected for greater milk production rely more on tissue energy adjustment to support milk production than on reduction of maintenance requirements.