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Introduction

The cow uses about 65% of the feed energy used in the production of beef cattle. Of that, about 74% is used for maintenance of the maternal body, 18% for lactation and 8% for pregnancy in the mature, producing beef cow. The growing-finishing animal uses about 35% of the total feed energy used for beef production. In the growing-finishing animal, maintenance costs may vary from 30 to 100% of the total feed energy consumed, with the lower proportion being at high intakes and rates of gain. Typically, in feedlot cattle this value ranges from 30 to 40%, whereas in cattle growing more slowly, such as stocker cattle, maintenance costs represent about 50 to 70% of the total. As a result, energy expenditures for maintenance are relevant to all phases of beef production, but are generally of greater importance in the cow herd.

Numerous breeds of cattle are currently available to beef cattle producers. Large differences among breeds for important traits such as mature size, growth rate, body composition, and milk production have been well documented. To effect improvements in efficiency, both required feed input and product output need critical examination. Differences among breeds or genotypes have also been observed with regard to energy requirements and/or efficiency of energy utilization for maintenance and weight or energy gain. Some of the research efforts at MARC in this regard were summarized in the previous Beef Research Progress Report (Ferrell and Jenkins, 1988). Those studies indicated that, in general, there appears to be a positive association between genetic potential for productivity and maintenance requirements. Stated another way, there is an antagonistic relationship between potential productivity and feed requirements for maintenance. Further understanding of relationships between utilization of feed energy and productive potential is needed in order to select appropriate genotypes for given production environments. The objective of the present study was to evaluate the relationship of animal energy expenditures to feed available in diverse genotypes.

Procedures

In 1986, mature, multiparous Hereford (10) and Simmental (10) cows were assigned to the study. Within each breed, cows were assigned to four levels of feed intake and were fed, individually in dry lot, at those levels for four years. Hereford cows received 47, 60, 72 and 85 grams dry feed per metabolic body size (MBS, weight in kilograms raised to the 0.75 power) and Simmental cows received 60, 72, 85, and 98 grams dry feed per MBS daily. Feed allowances were increased during lactation to sustain maternal weight. The feed used consisted of 70% ground alfalfa hay and 30% rolled corn and was supplemented with minerals and vitamins A, D and E. Cows were weighed at 28-day intervals. Milk production was measured at 28-day intervals, beginning 14 days after parturition.

Heat production was measured by open circuit, indirect calorimetry in this study. For this measurement, oxygen consumption and carbon dioxide and methane production are determined and heat production is calculated from those determinations by established procedures. Measurements were recorded for cows five times each year. Measurements were thus made on cows that were in four different physiological states: pregnant-nonlactating, nonpregnant-lactating, pregnant-lactating, and nonpregnant-nonlactating. Cows failing to conceive during the breeding season were measured to provide data on nonpregnant-nonlactating cows. Prior to the initiation of the study, all cows were trained to the facilities and equipment. During the acclimatization and collection periods, cows had access to water and daily feed allowances were provided. During lactation, calves had access to the cows.

Results and Discussion

Of the feed energy consumed, part is retained as body tissue, part is deposited in the fetus and other tissues of the uterus during pregnancy, part is secreted in milk during lactation and the remainder is lost as heat. Thus, heat production relative to feed intake is a measure of the inefficiency of the animal. In this study, each cow was fed a constant daily amount throughout the study (except for adjustments during lactation). As a result, weights plateaued, thus cows were at weight stasis which is essentially equivalent to maintenance. Weights maintained differed, depending on feed intake and efficiency of feed utilization.

The ranking of Simmental cows relative to Hereford cows was similar regardless of physiological state. Pooled over physiological state, estimated heat production of Hereford cows was less than estimated for Simmental cows at zero feed intake (Fig. 1). However, heat production increased more rapidly as feed intake increased in Hereford than in Simmental cows. The relationships of heat production to feed intake of the Hereford and Simmental cows intersected at 193 gram feed dry matter per kilogram body weight. Above that point, Simmental cows produced less heat than Hereford cows.

We suggest these results indicate the Hereford cows were more adaptable to low feed intakes than were the Simmental cows. Conversely, Simmental cows apparently used feed energy more efficiently than Hereford cows when chronically adapted to high levels of feed intake. These results are consistent with the concept that if environmental conditions limit productivity (e.g., inadequate nutrition), genotypes having lower production potential, and associated lower maintenance, are less adversely affected than genotypes having higher genetic potential. Conversely, if environmental conditions are not limiting, genotypes having the greatest potential productivity are favored.

FIGURE 1. RELATIONSHIP BETWEEN DAILY HEAT PRODUCTION AND DRY MATTER INTAKE POOLED ACROSS PHYSIOLOGICAL STATES.

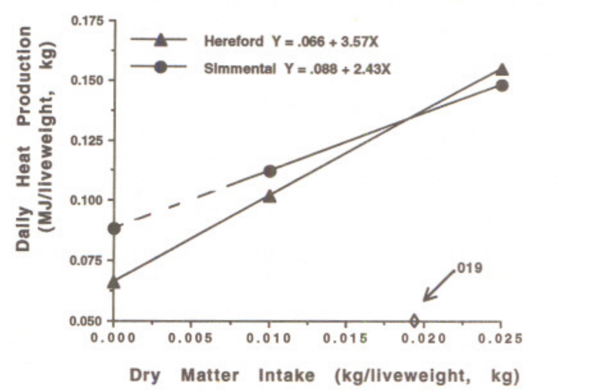

Figure 1 – Relationship Between Daily Heat Production and Dry Matter Intake Pooled Across Physiological States

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