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Introduction

Relative differences in expected performance for breed crosses of cattle are provided elsewhere in this report; see "Characterization of Breeds Representing Diverse Biological Types." This information may be utilized by beef cattle producers to identify breed types for possible use in their beef cattle enterprises. In conjunction with information descriptive of production characteristics, variation in energy requirements among the breed types needs to be considered. Using general relationships between production potential and energy requirements, producers may identify the beef cattle breeds that would perform optimally in their respective production environments.

Energy (either harvested by the animal or provided via supplementation) is used by animals to sustain life of the individual (maintenance) and for product formation (growth, gestation, and lactation). The energy available for metabolism by animals is referred to as metabolizable energy (ME). The information presented within this report demonstrates variation among breed crosses in energy requirements for animal production and documents variation in energy requirements for maintenance during specified periods of production.

Procedure

A series of studies has been initiated to estimate energy requirements of cattle breeds or breed crosses at specified points in the production cycle. To date, energy requirements have been estimated for straightbred Hereford and Simmental bulls and heifers during the postweaning period; mature Angus, Charolais, Hereford, and Simmental cows during lactation; and mature Angus, Hereford, and Simmental cows that were nonpregnant and non-lactating. In addition, four breed crosses from Cycle I and six breed crosses from Cycle II of the Germ Plasm Evaluation (GPE) program have been evaluated. Breed crosses from the GPE project, for which maintenance energy requirements have been estimated are: Hereford x Angus and Angus x Hereford (AH-X), Charolais x Angus or Hereford (C-X), Jersey x Angus or Hereford (J-X), Simmental x Angus or Hereford (S-X), Red Poll x Angus or Hereford (RP-X), Brown Swiss x Angus or Hereford (BS-X), Gelbvieh x Angus or Hereford (G-X), Maine Anjou x Angus or Hereford (MA-X), and Chianina x Angus or Hereford (CH-X).

Feed intake for individual animals or replicated pens within breed was recorded biweekly for all cattle. Within a specific study, the cattle were fed to maintain body weight or were assigned to a restricted or *ad libitum* feed intake level. Body composition was estimated at the initiation and termination of the trials involving AH-X, C-X, J-X, S-X, and the Simmental and Hereford bulls and heifers via dilution techniques. Energy requirements for maintenance were predicted by regressing change in body energy or weight on metabolizable energy intake within each breed or breed cross.

Results

Information in Figure 1 depicts predicted annual energy requirements (Mcal ME) for mature cows representing four breed crosses produced in Cycle I of the GPE project that varied in genetic potential for mature size and milk production potential. The AH-X, C-X, J-X, and S-X have been previously characterized as exhibiting moderate-moderate, large-moderate, moderate-high and large-high genetic potential for mature size and milk production, respectively. The reported values are expressed relative to the AH-X for three physiological states (lactation, gestation, and maintenance) in mature cows. Relative to the AH-X, the S-X, J-X, and C-X required 28 percent, 6 percent, and 9 percent more energy for an annual production cycle. For the AH-X, approximately 19 percent of the ME was expended for lactation and 8 percent for gestation. The predicted energy expenditure of the C-X, J-X, and S-X breed crosses for gestation was similar. Differences among the breed crosses for ME expenditure for lactation reflect differences in total milk yield among the cows. For all breed crosses, the largest proportion of ME was spent for maintenance. Additionally, the greatest variation among the breed crosses for ME requirements was for maintenance. Two facts suggested by this information are: 1) differences exist in annual energy requirements among breed crosses that differ in genetic potential for mature size and lactation, and 2) the largest proportion of ME expenditure was associated with maintenance.

Estimates of maintenance requirements from several studies involving breeds and breed crosses varying in physiological states are reported in Table 1. Maintenance requirements are expressed as kilocalories of ME per unit metabolic size (weight in kilograms raised to the .75 power). The information is reported by trial within physiological state.

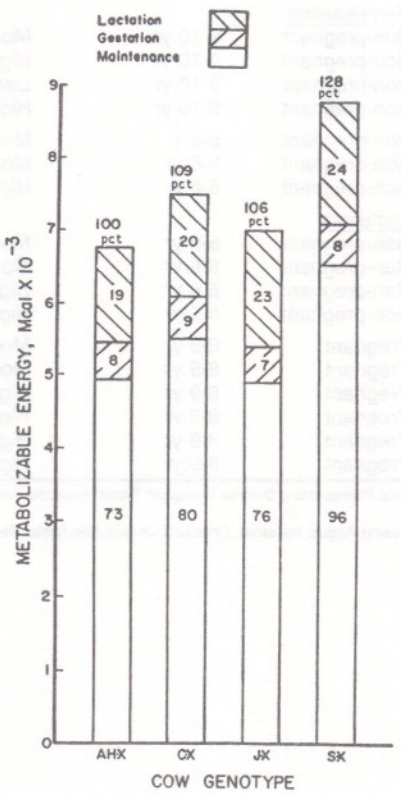

Figure 1—Estimated annual production cycle metabolizable energy requirements for Angus x Hereford-Hereford x Angus (AH-X), Charolais x Angus/Hereford (C-X), Jersey x Angus/Hereford (J-X) and Simmental x Angus/Hereford (S-X).

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During the finishing period, two breeds that would be expected to differ in postweaning growth rate were evaluated. The energy requirement for maintenance of the Simmental was greater than for the Hereford (126 *vs* 106 Kcal ME/wt$^{.75}$/day). Relative to the average of the two breeds, Simmental required approximately 8 percent more energy per unit of metabolic size and Hereford, approximately 9 percent less.

Among non-lactating, non-pregnant F_1 cows from Cycle I of the GPE project, the S-X and J-X required a greater amount of ME per unit metabolic size than did the AH-X and C-X cows. Although the mature size of the C-X was greater than the AH-X, the energy requirements relative to metabolic body size were similar. These results suggest that genetic potential for lactation has a greater effect on maintenance energy requirements than size *per se*.

Among lactating Cycle II F_1 cows, the CH-X cows required the most ME per unit metabolic size and the MA-X required the least. Relative to the average of the six breed crosses involved in the study, the RP-X, G-X, and BS-X were similar to the average with the AH-X requiring approximately 4 percent less ME for maintenance.

Comparing straightbred cattle during non-lactating and lactating periods, the relative differences among the breeds remained approximately the same. The Simmental required more energy for maintenance than the Angus and Hereford during both the non-lactating and lactating physiological states. However, the ME requirements associated with metabolic body size were increased for Angus, Hereford, and Simmental during lactation relative to the non-lactating period. The ME requirements of the Charolais were similar to those of Simmental during lactation.

Efficient beef production requires the effective utilization of the resources that are available. Information is available documenting differences among breeds or breed crosses for output characteristics such as reproductive performance, growth, and lactation. There is increasing evidence that variation also exists among breeds for energy requirements during a production cycle. Metabolizable energy expenditure may be partitioned into the two broad classifications of maintenance and production (i.e., tissue accretion, lactation, etc.). The proportion of energy consumed that is expended upon the maintenance component exceeds the proportion utilized for production function. Variation among breeds or breed crosses in energy expenditure for maintenance has been documented.

Table 1.—Estimates of metabolizable energy required for maintenance of various breeds or breed crosses

Breed or breed cross	Physiological state	Age	Biological type classification for potential performance[a]		Maintenance (kcal/kg.^{75}/d)	Ratio[b] (pct)
			Growth rate and mature size	Milk production		
	Finishing					
Hereford	Growing	9-15 mo	Moderate	Low	106	91
Simmental	Growing	9-15 mo	High	High	126	108
	Non-lactating					
Angus-Hereford[c]	Non-pregnant	9-10 yr	Moderate	Moderate	130	92
Charolais-X	Non-pregnant	9-10 yr	High	Low	129	91
Jersey-X	Non-pregnant	9-10 yr	Low	High	145	103
Simmental-X	Non-pregnant	9-10 yr	High	High	160	113
Angus	Non-pregnant	5-6 yr	Moderate	Moderate	118	95
Hereford	Non-pregnant	5-6 yr	Moderate	Low	120	97
Simmental	Non-pregnant	5-6 yr	High	High	134	108
	Lactating					
Angus	Non-pregnant	5-6 yr	Moderate	Moderate	149	96
Hereford	Non-pregnant	5-6 yr	Moderate	Low	141	91
Simmental	Non-pregnant	5-6 yr	High	High	166	107
Charolais	Non-pregnant	5-6 yr	High	Low	165	106
Angus-Hereford[c]	Pregnant	8-9 yr	Moderate	Moderate	151	96
Red Poll-X	Pregnant	8-9 yr	Moderate	High	157	100
Brown Swiss-X	Pregnant	8-9 yr	High	High	156	99
Gelbvieh-X	Pregnant	8-9 yr	High	High	158	100
Maine Anjou-X	Pregnant	8-9 yr	High	High	146	93
Chianina-X	Pregnant	8-9 yr	High	Low	174	111

[a]See "Characterization of Breeds Representing Diverse Biological Types: Reproduction and Maternal Performance of F_1 Cows" in this publication.
[b]Ration within study.
[c]Crossbred cows produced by using Angus, Hereford, Charolais, Jersey, Simmental, Red Poll, Brown Swiss, Gelbvieh, Maine Anjou, or Chianina purebreds mated to Angus or Hereford cows.