1985

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Introduction

Observed growth of cattle during the postweaning period reflects the genetic potential for growth as modified by the environment. Various breeds or breed crosses of cattle have been characterized for postweaning liveweight gain under *ad libitum* feeding conditions. Previous results showed calves by Simmental males had greater rates of postweaning gain than those sired by Hereford males. Simmental-sired steers were more efficient during a weight-constant interval, of equal efficiency during a time-constant interval and less efficient to a fat-constant end point than Hereford-sired steers. Differences among breeds in efficiencies of energy utilization for maintenance and gain have been reported. Similarly, differences among sexes (or sex condition) in growth rate and carcass characteristics have been documented. Efficiencies of energy utilization for maintenance and gain of castrate males have been reported to be similar to those of females. However, other results have suggested that intact males had higher maintenance requirements than castrate males.

This paper describes the accretion of total empty body weight, water, fat, protein, and energy by Hereford and Simmental males and females in response to differing rates of metabolic energy (ME) intake. Estimates of breed and sex effects on ME requirements for maintenance and efficiencies of utilization of ME for maintenance and gain are reported.

Procedure

Hereford and Simmental intact males and females (18 of each breed x sex group) were obtained from the research center herds about two weeks after weaning (210 days of age). Six calves of each breed x sex group were assigned to one of 12 pens and allowed a 28-day period for adjustment to the diet and to individual feeding by electronic headgates. One pen of calves of each breed and sex was fed a high concentrate diet at a low, medium, or high (*ad libitum)* level. The diet contains 1.38 Mcal ME/lb and 13.9 percent crude protein. Calves were fed individually, once daily, for about 212 days.

One Hereford male (low), two Hereford females (one low, one high), three Simmental males (two high, one low) and two Simmental females (medium) were removed from the study due to failure to adapt to the electronic headgates, poor health, or death. The data reported describe a total of 64 animals that remained on the study.

All calves were weighed at the initiation of the study and at 28-day intervals until completion. The individual food allowances of restricted groups were based on each individual's initial weight. Feed allowances were adjusted at 28-day intervals to maintain daily intakes per unit metabolic body size ($kg^{0.75}$). At 84 days into the study, feed allowances of calves assigned to the restricted levels were adjusted upward because of low or negative weight gains. Unconsumed feed was collected and weighed weekly throughout the feeding period. Samples of feed were taken daily, frozen, composited at 28-day intervals, and subsequently analyzed for dry matter and crude protein. On day 0 and about day 212, deuterium oxide was used to estimate body composition.

Results

Hereford females weighed less and contained less water and protein but more fat than Hereford males at the start of the study (Table 1). Neither liveweight nor any of the empty body components differed significantly between Simmental males and females at this time, but Simmental cattle had greater total weights and weights of water and protein than Hereford cattle. The empty bodies of Hereford males, Simmental males and Simmental females contained similar proportions of water, fat, and protein. Hereford females tended to contain lower proportions of water, a higher proportion of fat, and a similar proportion of protein when compared to other animals. These results suggest that Hereford heifers, possibly because of a high propensity toward fatness and a relatively low impetus for lean growth, had begun to fatten at an earlier age than other animals included in the study.

Simmental cattle had greater daily ME intakes (Table 2) than Hereford cattle, and males had greater daily ME intakes than females. The observed differences reflected, in part, the experimental design, since low and medium intakes were governed by body size, but also resulted from the initial weights and rates of gain achieved by cattle assigned to the different treatments. Simmental cattle gained empty body weight slightly faster than Hereford cattle, and males gained weight more rapidly than females. Hereford males gained fat and energy slightly more rapidly than Hereford females, whereas Simmental males gained fat and energy less rapidly than Simmental females. Protein and water gain of Hereford and Simmental cattle were similar at restricted levels of intake, but gains of these components were greater for Simmental than for Hereford at *ad libitum* intakes. Similarly, rates of protein and water gain increased more rapidly in response to increased intake by males as compared to females. Hereford males and females tended to gain energy at similar rates, but Simmental males gained energy less rapidly than Simmental females.

These results were consistent with observations made of composition of rib section soft tissue of these cattle at slaughter. Results of other studies in which breeds or breed crosses differing in growth potential or sex are consistent with data obtained in this study on cattle fed *ad libitum.* These results further document that at *ad libitum* intakes, total weight of components of lean tissue (water and protein) gains of Simmentals were greater than those of Herefords; however, this advantage was not observed at lower intake levels. Similar results were observed when males were compared to females. These results indicate the benefits that may result from increased potential for weight or lean tissue gain may be realized only if the environment is suitable to support the greater gains.

Simmental cattle had greater ($P<.05$) ME requirements for maintenance (energy stasis) than Hereford cattle, and males had greater requirements than females. The ME available for gain did not differ significantly between breed or sex groups, but energy gain of Herefords was greater than that of Simmentals. Efficiency of utilization of ME for maintenance or gain of Herefords was greater than that of Simmentals. These results are consistent with previous reports which showed that Simmental or Simmental-cross cattle had greater requirements for maintenance than Angus or Hereford cattle. Other reports indicated Hereford cattle had lower requirements for maintenance than Holsteins, and that Angus or Hereford steers had lower predicted basal metabolic rates than Friesian steers. Results from these and various other studies have often been interpreted to indicate that body protein has a higher energy cost of maintenance and a lower efficiency of gain than body fat. Other data has been interpreted to indicate that cattle with a greater genetic potential for growth have greater maintenance requirements than those with less potential for growth.

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Table 1.—Initial animal weights and weights of empty body chemical components

	Hereford		Simmental	
	Male	Female	Male	Female
No. of animals	17	16	15	16
Liveweight, lb	514	470	666	644
Empty body weight, lb	459	423	602	580
Empty body water, lb	320	273	419	401
Empty body fat, lb	30	52	38	38
Empty body protein, lb	88	80	119	111
Empty body energy, MJ	1,409	1,700	1,831	1,785

Table 2.—Daily metabolizable energy (ME) intake and gains of empty-body components

						Daily empty body gains				
Breed	Sex	Ration	No. of animals	Days on feed	ME intake MJ/day	Total weight, lb	Water, lb	Fat, lb	Protein, lb	Energy, MJ
Hereford	Male	Low	5	212	36.8	.64	.22	.29	.10	6.12
		Medium	6	215	58.5	1.68	.76	.56	.28	12.60
		High	6	206	87.8	2.58	.93	1.12	.41	23.94
	Female	Low	5	209	33.6	.53	.16	.26	.08	5.43
		Medium	6	212	48.8	1.32	.58	.47	.22	10.45
		High	5	211	82.6	2.18	.69	1.06	.34	22.20
Simmental	Male	Low	5	211	49.9	.64	.31	.19	.11	4.47
		Medium	6	214	67.8	1.72	.93	.41	.31	10.31
		High	4	215	103.0	2.82	1.53	.67	.50	16.76
	Female	Low	6	206	47.1	.71	.28	.29	.11	6.08
		Medium	4	207	58.4	1.26	.40	.60	.20	12.56
		High	6	210	96.8	2.45	.96	.99	.40	21.49

Table 3.—Means for utilization of metabolizable energy (ME) by Hereford and Simmental males and females

	Breed		Sex	
Item[a]	Hereford	Simmental	Male	Female
ME intake	872	894	898	868
Maintenance	446	530	514	462
ME for gain	426	363	385	406
Energy gain	198	148	165	182
Maintenance efficiency	.66	.62	.63	.65
Gain efficiency	.49	.42	.43	.48

[a]ME intake, maintenance, ME for gain and energy gain are expressed as KJ/$kg^{0.75}$/day. Efficiency values are expressed as kJ/kJ.