

## The effects of genetic merit on nutrient utilization in lactating dairy cows

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### Introduction

The United Kingdom dairy industry is entering a period of rapid increase in cow genetic merit (CGI90) through the use of Holstein breeding material from North America and Holland. The current study examined the effects of genetic merit on performance and nutrient utilization of lactating dairy cows.

### Material and methods

Cows of high, medium and low genetic merit (CGI90 approx. 950, 650 and 550) were offered a diet with a forage (grass silage: dry matter (DM) 228 g/kg, digestible organic matter in the dry matter value 759 g/kg) to concentrate ratio of 36:64 on a DM basis from day 11 to day 160 of lactation. A total of 36 animals, 12 animals (10 cows plus two heifers) of each merit, were used in a randomized-block design. During each sequential 50 day period of the study

totals of four, six and six blocks of three animals from within the feeding study were subjected to diet apparent digestibility and nitrogen (N) balance measurements, followed by open-circuit calorimetry.

### Results and discussion

Milk yield (Figure 1 and Table 1) was influenced by cow genetic merit and reached a mean peak of almost 40 kg/day for the high merit animals. The DM intake of the high merit cows was proportionately 0.06 higher than for the low merit animals, while intakes of the medium merit animals were intermediate. Intakes were similar when related to metabolic live weight. The small difference in DM intake across genetic merits, coupled with the much higher mean yields with the high merit animals, resulted in higher rates of live-weight depletion during the first 6 weeks of lactation (Figure 2). The

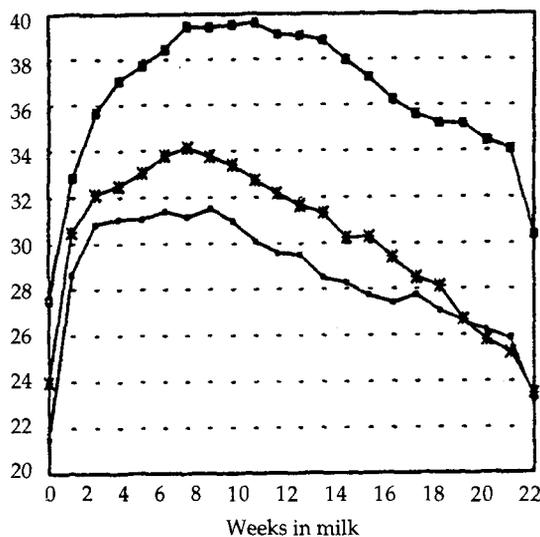


Figure 1 Milk yield by stage of lactation (kg/day): —●— low-index, —\*— medium-index, —■— high-index.

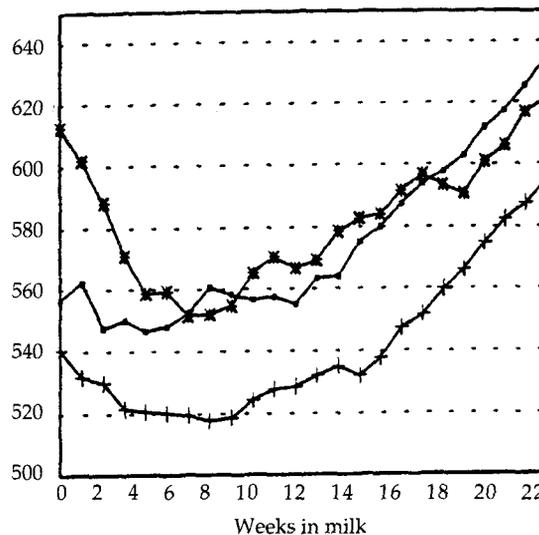


Figure 2 Live weight by stage of lactation (kg): —●— low-index, —+— medium-index, —\*— high-index.

**Table 1** *The effects of cow genetic merit on animal performance and nutrient utilization*

	Cow genetic merit			s.e.	Significance
	High	Medium	Low		
Total dry matter intake (kg/day)	20.2	19.4	19.0	0.46	
Metabolizable energy (ME) intake (MJ/day)	257	249	247	6.1	
ME/gross energy†	0.669	0.673	0.683	0.004	
Milk yield (kg/day)	37.2 <sup>a</sup>	30.6 <sup>b</sup>	29.0 <sup>b</sup>	1.37	***
Milk energy (MJ/day)	117	99	90	3.6	***
Butterfat yield (kg/day)	1.40 <sup>a</sup>	1.20 <sup>b</sup>	1.06 <sup>c</sup>	0.05	***
Protein yield (kg/day)	1.14 <sup>a</sup>	0.99 <sup>b</sup>	0.90 <sup>b</sup>	0.04	***
Lactose yield (kg/day)	1.89 <sup>a</sup>	1.55 <sup>b</sup>	1.49 <sup>b</sup>	0.07	***
Initial live weight (kg)	631 <sup>a</sup>	551 <sup>b</sup>	528 <sup>b</sup>	16.7	***
Live-weight gain (kg/day)	-0.02 <sup>a</sup>	0.34 <sup>b</sup>	0.53 <sup>b</sup>	0.084	***
Milk energy/ME intake	0.46	0.40	0.36	0.012	***
Milk N/N intake	0.31	0.27	0.26	0.010	**
$k_i$ ‡	0.62	0.57	0.55	0.021	

† Determined using measurement of methane production.

‡ Calculated using ARC (1980) data for energy content of body weight change.

higher merit animals also had a much lower rate of body reserve repletion during the mid-lactation period.

Metabolizable energy (ME) intake was highest with the high merit animals, but the differences in ME intake were not significant ( $P > 0.05$ ). Milk energy output increased very considerably ( $P < 0.001$ ) with increase in genetic merit and gross energetic efficiency, expressed as milk energy as a proportion of ME intake was highest with the high index cows. Milk N/N intake also increased with increase in genetic merit. Values for  $k_i$  for animals in the production study were estimated using assumed values for maintenance requirement (Agricultural Research Council (ARC), 1980), and energy contents of live-weight change (Agricultural and Food Research Council, 1990) and the ME intake and milk energy outputs obtained in the overall production study. The  $k_i$  values were similar across the genetic merits.

## Conclusions

1. Cow genetic merit had a considerable influence on the outputs of milk, milk components and milk

energy with mean treatment yields of approximately 40 kg/day being obtained for the highest index animals in early lactation.

2. DM and energy intakes were only slightly increased with increasing genetic merit, therefore increasing genetic merit resulted in increased mobilization of body reserves.

3. Partial efficiency of ME use for milk production,  $k_i$ , was not significantly affected by genetic merit.

## References

- Agricultural and Food Research Council.** 1990. Nutritive requirements of ruminant animals: energy. Technical Committee on Responses to Nutrients; report no. 5. *Nutrition Abstracts and Reviews, Series B* **60**: 729-804.
- Agricultural Research Council.** 1980. *The nutrient requirements of ruminant livestock*. Commonwealth Agricultural Bureau, Slough.