A STUDY ON FEED EFFICIENCY OF YOUNG BEEF BULLS IN A TEST STATION

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SUMMARY

The records of 282 young beef bulls from different breeds tested from November 1981 to April 1987 at the Ellerslie Bull Test Station, Alberta, Canada were used to investigate the variation in feed efficiency among young performance tested bulls. The study showed that there existed sufficient variation in feed consumption independent of maintenance and growth. This variation was to a great extent genetically determined. For rapid improvement in feed efficiency in beef cattle, selection pressure should be applied to both growth traits and independent feed efficiency traits.

Keywords: feed efficiency, residual ME consumption, beef bulls.

INTRODUCTION

Feed cost represents a major economic input, approximately 70% of the total cost of a beef cattle finishing enterprise, Of feed cost the energy cost of the ration is the major portion, approximately 89% of the total. Thus the cost of energy portion represents approximately 62% of the total cost of the enterprise (Perry *et al.*, 1995).

Differences among individual cattle in their ability to efficiently utilize feed have long been recognized (Garrett 1971). Current research is focusing on the variation in feed consumption beyond requirements for maintenance and growth among animals (Fan *et al.* 1995, Trangie Project DAN. 75).

The objectives of this study were to investigate the variation in feed efficiency among young beef bulls in a central test station and to evaluate the genetic determination of the variation.

MATERIALS AND METHODS

The records of 282 young beef bulls from different breeds tested from November 1981 to April 1987 at the Ellerslie Bull Test Station, Alberta, Canada were used for this study. After an adjustment period of 28 days, a 140-day postweaning performance test started in mid-November each year (test group). On-test age of bull ranged from 182 to 307 days. However, the range of on-test age in each test group did not exceed 90 days. The distribution of dams with ages of 2, 3, 4, 5–10 and $\geq$ 11 years old was 21.7, 11.6, 14.1, 51.0 and 1.6%, respectively. Management of the station generally followed the Guidelines for Uniform Beef Improvement Programs (BIF 1986). The young bulls were cared for under guidelines comparable to those laid down by the Canadian Council of Animal Care, housed in pens containing five bulls each, and fed *ad libitum* high energy diets composed of barley, oats, canola meal, molasses, beet pulp, and protein-mineral-vitamin supplement. Dry matter content (DM, %), metabolizing energy (ME, Mcal/kg DM), net energy for maintenance (NEm, Mcal/kg DM) and net energy for growth (NEg, Mcal/kg DM) of the diets are presented in Table 1. The energy levels of the diets were fairly constant from year to year. High quality hay (mainly alfalfa) was available free choice, depending on appetite. Animals were weighed at 28-day intervals. Individual feed intake was recorded by a Pinpointer (Model 4000A, Universal Identification System Corp., Cookeville, TN). Residual ME consumption (RMEC) and residual DM consumption (RDMC) used as measures of feed efficiency were estimated using formulas published by NRC (1984) as described below.

Table 1. DM and energy contents of concentrate diets

Test Group	DM (%)	ME (Mcal/kg DM)	NEm (Mcal/kg DM)	NEg (Mcal/kg DM)
1981, 1982	88	2.74	1.82	1.19
1983	88	2.71	1.80	1.18
1984, 1985	88	2.62	1.72	1.12
1986	89	2.70	1.79	1.17

DM – dry matter content, ME – metabolizing energy, NEm – net energy for maintenance, and NEg - net energy for growth.

In the first step, net energy requirements in megacalories for maintenance (NERm) and for growth (NERg) of individual bulls during the test were estimated based on average liveweights in each of the five 28-day periods (W_i) and liveweight gains in each of the five 28-d periods (LWG_i).

$$NERm = 28(0.077)\sum W_i^{0.75}$$

$$NERg = 0.0437\sum W_i^{0.75} LWG_i^{1.097}$$

In the second step, efficiencies of ME from the diets for maintenance (NEm/ME) and growth (NEg/ME) were used to calculate ME requirements for maintenance (MERm) and growth (MERg), respectively, in megacalories.

$$MERm = NERm / (NEm / ME)$$

$$MERg = NERg / (NEg / ME)$$

Thus ME requirement for both maintenance and growth (MER) in megacalories was

$$MER = MERm + MERg$$

Expected DM intake in kilograms was then calculated as

EDMI = MER / ME

In the third step, actual ME intake (AMEI) in megacalories was calculated from actual DM intake (ADMI) in kilograms and ME content of the diet.

AMEI = ADMI x ME

Residual ME consumption (RMEC) in megacalories and residual DM consumption (RDMC) in kilograms were thus calculated as

RMEC = AMEI – MER

RDMC = ADMI – EDMI

Statistical analyses were then performed on the variables related to feed efficiency.

RESULTS AND DISCUSSION

There existed sufficient variation in RMEC. The range was 2450 Mcal equivalent to approximately 920 kg DM (Table 2), indicating that some bulls were much more efficient in utilizing energy than others. Should the cost be $0.10/kg DM, the most efficient animal would save $48.20 while the worst animal would waste $43.88. The difference in feed costs between these two animals then would be $92.08. The variation in RMEC found in this study agreed with Fan *et al.* (1995).

Table 2. Basic statistics of traits related to feed efficiency

Trait	Mean	SD	Min.	Max.
ADG (kg/d)	1.58	0.21	1.09	2.13
FGR (kg/kg)	6.76	0.96	4.83	9.98
AMEI (Mcal)	4387.00	573.00	2729.18	5949.74
MER (Mcal)	4615.00	576.56	3155.02	6066.59
RMEC (Mcal)	-227.96	422.89	-1267.27	1182.59
ADMI (kg)	1633.68	222.08	994.96	2272.63
EDMI (kg)	1718.33	222.11	1150.21	2249.95
RDMC (kg)	-84.65	157.42	-481.92	438.80

ADG - average daily gain, FGR - feed to gain ratio, AMEI – actual metabolizing energy intake, MER – metabolizing energy requirement, RMEC – residual metabolizing energy consumption, ADMI – actual dry matter intake, EDMI – expected dry matter intake, and RDMC – residual dry matter consumption.

Heritability estimates of RMEC and consequently of RDMC were high (Table 3), indicating that there existed sufficient genetic variation in feed efficiency independent of maintenance and growth among young beef bulls performance tested in a central test station. Fan *et al.*

(1995) reported much lower heritability estimates of RMEC/d in populations under selection pressure for postweaning gain.

Table 3. Heritability estimates of traits related to feed efficiency

	RMEC (Mcal)	RDMC (Mcal)
h^2	0.76	0.76
$\sigma(h^2)$	0.40	0.40

RMEC – residual metabolizing energy consumption and RDMC – residual dry matter consumption.

RMEC and RDMC were negatively correlated with ADG (Table 4), indicating that fast growing animals are more efficient in utilizing feeds. However, the correlation (r = -0.44) was not high. For rapid improvement of feed efficiency, selection pressure should be applied to the variation in feed efficiency independent of maintenance and growth. The correlation between RMEC or RDMC and feed to gain ratio (FGR) was high (r = 0.73), indicating that higher RMEC results in higher FGR.

Table 4. Phenotypic correlation estimates of traits related to feed efficiency

Trait	ADG (kg/d)	FGR (kg/kg)	RMEC(Mcal)	RDMC (Mcal)
ADG		-0.51	-0.44	-0.44
FGR			0.73	0.73
RMEC				0.99

ADG – average daily gain, FGR – feed to gain ratio, RMEC – residual metabolizing energy consumption, and RDMC - residual dry matter consumption.

In summary, the results of this study showed that there existed sufficient variation in feed efficiency independent of maintenance and growth in young beef bulls. This variation was to a great degree genetically determined. For rapid improvement in feed efficiency in beef cattle, selection pressure should be applied to both growth performance and independent feed efficiency parameters such as RMEC or RDMC.

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