IDENTIFICATION AND ASSESSMENT OF THE BEST ANIMALS : THE KLEIBER RATIO (GROWTH RATE /METABOLIC MASS) AS A SELECTION CRITERION FOR BEEF CATTLE

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SUMMARY

Feed conversion efficiency (FCE) has a major influence on the efficiency of beef production. However, it can only be evaluated with individual feeding. The Kleiber ratio (growth rate/final mass$^{0.75}$) was investigated for its suitability as an indirect selection criterion for efficiency. Data of 298 Bonsmara bulls, tested post weaning under feedlot conditions, were used. FCE and Kleiber ratio (KR) showed similar correlations with most other traits. The heritability of KR (0.52) is similar to that of growth rate (0.48) and much higher than that of FCE (0.19). The correlation between KR and FCE (0.70) is higher than between growth rate and FCE (0.65). KR showed lower correlations than ADG with birth and final mass as well as feed intake. KR has definite advantages over growth rate as an indirect selection criterion for FCE and can be effectively used where individual feed intake cannot be determined.

INTRODUCTION

Much work has been done on the estimation of genetic parameters for production traits in beef cattle, but growth rate still receives the most attention and is the primary selection criterion in many breeding schemes (Barlow, 1984). This is despite the fact that the relationship between growth rate of the slaughter progeny and overall efficiency of the production system is poor (Dickerson, 1978; Roux, 1992). Selection for growth rate results in an increased mature size, which increases maintenance costs. The maintenance requirements for cattle are large, hence efficiency is essential for successful production (Pollak, 1990). Thompson and Barlow (1986) showed that increasing feed conversion efficiency had a large effect on overall efficiency of the production system. It is thus clear that alternative selection criteria are required for beef cattle.

Direct selection for efficiency is not always practical as it is labour- intensive and expensive (Scholtz et al. 1990). Thus alternative indirect methods should be investigated. The ratio (growth rate/mass$^{0.75}$) was suggested as early as 1936 (Kleiber, 1936) as an indirect measure of efficiency. In this study the Kleiber ratio is being investigated for its suitability as an indirect selection criterion for efficiency.

MATERIALS AND METHODS

The data of 298 Bonsmara bulls, subjected to a 140-day post weaning growth test under intensive conditions (individual feeding), were used in this study. The data were analysed with the LSMLMW computer program of Harvey (1988) using Henderson's Method III for estimating genetic parameters. The traits involved were birth mass (BM), weaning (205 days) mass (WM), initial (260 days) mass at beginning of feedlot test (IM), final mass (400 days) at end of feedlot test (FM), feed intake (FI), growth rate (ADG), feed conversion efficiency (kg live weight gain/kg feed consumed) (FCE) and the Kleiber ratio during test (KR). The KR was defined as ADG/400-day mass$^{0.75}$ where ADG is the growth rate during the 140-day feedlot test and 400-day mass is the age-corrected final mass at the end of the 140-day feedlot test.

RESULTS AND DISCUSSION

The heritabilities, phenotypic and genetic correlations are presented in Table 1.

Table 1. Heritabilities (h^2), phenotypic (r_p) and genetic correlations (r_g) for traits evaluated

	BM	WM	IM	FM	FI	ADG	FCE	KR
BM	**0.48**	0.28	0.32	0.36	0.09	0.25	0.19	0.08
	(0.21)							
WM	0.33	**0.64**	0.60	0.52	0.11	0.20	0.15	-0.08
	(0.30)	**(0.23)**						
IM	0.38	0.80	**0.41**	0.80	0.40	0.24	-0.09	-0.26
	(0.33)	(0.16)	**(0.20)**					
FM	0.27	0.44	0.73	**0.39**	0.59	0.77	0.35	0.37
	(0.35)	(0.28)	(0.18)	**(0.19)**				
FI	-0.02	0.00	0.47	0.87	**0.37**	0.53	-0.29	0.32
	(0.39)	(0.36)	(0.32)	(0.18)	**(0.19)**			
ADG	0.02	-0.14	0.07	0.74	0.81	**0.48**	0.65	0.88
	(0.36)	(0.32)	(0.37)	(0.17)	(0.20)	**(0.21)**		
FCE	0.03	-0.31	-0.40	0.25	0.21	0.75	**0.19**	0.70
	(0.50)	(0.48)	(0.49)	(0.59)	(0.50)	(0.75)	**(0.16)**	
KR	-0.15	-0.47	-0.35	0.39	0.55	0.91	0.88	**0.52**
	(0.35)	(0.31)	(0.39)	(0.32)	(0.30)	(0.07)	(0.78)	**(0.21)**

h^2 on the diagonal (standard errors in brackets)
r_p above the diagonal
r_g below the diagonal (standard errors in brackets)

Large samples are required for accurate estimates of genetic correlations. Hence, Cheverud (1988) suggested the use of phenotypic correlations rather than their genetic counterparts in situations where genetic correlations cannot be accurately estimated. Since there were some dissimilarities between phenotypic and genetic correlation estimates in this study (Table 1) phenotypic correlations were used.

The phenotypic correlations between KR and the other traits are very similar to those between FCE and the other traits. The only discrepancy is in the correlation with FI, where an improvement in FCE will decrease FI slightly (r_p = -0.29) while an improvement in KR will increase FI slightly (r_p = 0.32). KR showed lower correlations than ADG with BM (r_p = 0.08 and 0.25 respectively), FM (r_p = 0.37 and 0.77 respectively) and FI (r_p = 0.32 and 0.53 respectively). Furthermore, KR has a higher correlation with FCE (r_p = 0.70) than that of ADG with FCE (r_p = 0.65) while both FCE and KR are relatively independent of FM (r_p = 0.35 and 0.37 respectively). KR is affected more than FCE by IM (r_p = -0.26 and -0.09 respectively).

The heritability estimates for birth and weaning mass (Table 1) are higher than values quoted in literature (Lasley, 1978). Only bull calves with weaning indices above 90 are evaluated in the post weaning growth test. This might explain the higher heritabilities as it is a selected group. The heritability estimates for post weaning traits are in agreement with values quoted in literature. The heritability of KR ($h^2 = 0.52$) is similar to that of ADG ($h^2 = 0.48$) and much higher than the rather low heritability of FCE ($h^2 = 0.19$) during the 140-day test period.

Expected correlated responses were also calculated using conventional formulae (Falconer, 1981) and are presented in Table 2.

Table 2. Estimated correlated responses (%) when ADG, FCE or KK is improved by 10% ($CR_xY = 10r_G \sigma_{Gy}X/\sigma_{Gx}Y$)

% Change in:	10% improvement in:		
	ADG	FCE	KR
BM	2.6	3.5	1.2
WM	1.6	1.9	-0.9
IM	1.7	-1.0	-2.5
FM	4.7	3.6	3.1
FI	3.7	-3.5	3.1
ADG	-	11.1	12.0
FCE	3.8	-	5.6
KR	6.4	8.7	-

From Table 2 it seems that selection for KR will have the least effect on BM and FM. Furthermore, FCE will improve by 5.6% for every 10% improvement on KR, while a 10% improvement in ADG will only improve FCR by 3.8%.

CONCLUSION

Considering the fact that KR has a fairly high heritability, has a higher correlation with FCE than ADG does, and has lower correlations with BM, FM and FI than ADG does, it would appear to have definite advantages over ADG as an indirect selection criterion for efficiency in beef cattle under feedlot conditions where individual feed intake cannot be determined. A similar study with heifers under extensive conditions confirmed the above results and indicates that KR can also be used as an indirect selection criterior for FCE under extensive conditions.

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