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EFFICIENCY OF FEED CONVERSION IN FRIESIAN AND ANGUS STEERS

A. D. H. JOBLIN
Ruakura Agricultural Research Centre, Hamilton

SUMMARY

Two feeding trials where cattle were individually fed on cut pasture and roughage were used to compare the feed conversion efficencies of Friesian and Angus steers. In Trial 1, groups of 8 Friesian and 14 Angus steers growing from 13 to 18 months were compared with a younger group of Friesian steers growing from 8 to 13 months. In Trial 2, 20 Friesian and 24 Angus steers were grown from 8 to 19 months while being stall fed in indoor and outdoor environments. Conversion efficiencies were calculated in terms of kg dry matter per kg liveweight gain, carcass weight gain and components of carcass weight gain.

No significant differences in any form of feed conversion efficiency were found between breeds, when adjusted for differences in mean liveweights. The latter was negatively correlated with feed conversion efficiency.

UNDER systems of grazing management in New Zealand, Friesian steers have a higher growth potential than Angus steers (Barton, 1966; Everitt *et al.*, 1969). No information has been reported from New Zealand, or from overseas, on comparisons of these two breeds, for efficiency of conversion of pasture, and pasture supplemented fodders, into liveweight gain, carcass weight gain, or components of carcass weight gain.

In this paper the data from two trials with Friesian and Angus steers were examined to compare the feed conversion efficiencies of both breeds.

EXPERIMENTAL

TRIAL 1 (1967-8)

The trial commenced in October 1967 and continued until March, 1968. The primary objective was to examine compensatory growth responses following different levels of winter feeding (Joblin, 1969a). Throughout the trial cattle were fed daily indoors in individual stalls on fresh cut pasture.

Eight Friesian and 14 Angus steers, all spring-born and single-suckled at Whatawhata Hill Country Research

Station were used. A third group comprised eight Friesian steers born in autumn 1967 and bucket reared at Ruakura. Four feeding treatments were used and the cattle were distributed in the ratio of 2 spring-born Friesian, 3 or 4 Angus and 2 autumn-born Friesian steers per treatment.

TRIAL 2 (1968)

This trial (Joblin, 1969b), designed to study winter feeding rations and subsequent compensatory growth patterns, started in May 1968 with a 15-week period on either hay or maize silage plus one of two levels of autumn saved pasture. This was followed by 32 weeks of pasture feeding *ad lib.* Thus data for stall-fed animals were obtained over a total of 47 weeks. Twenty Friesian and 24 Angus steers, all born at Whatawhata in the spring of 1967, were used. The Angus cattle had been single-suckled, but the Friesians were an equal mixture of single- and double-suckled stock. All available Friesian steers were used in the trial, but only the heaviest 30% of the Angus steers available were selected. Three Friesian and five Angus steers were slaughtered at the commencement of the trial and carcass specific gravity measurements taken to estimate initial carcass composition. The trial was replicated under both indoor and outdoor stall feeding conditions, with Friesian and Angus steers distributed to all treatments in proportion to the total numbers available.

At slaughter the carcasses were hung for 24 hours at 7° C prior to measurement of specific gravity.

RESULTS AND DISCUSSION

TRIAL 1

The growth rates of these animals (Table 1) demonstrated the expected superiority of Friesians compared with Angus. The spring-born animals showed an 11% improvement in growth rate and the younger autumn-born group a 4% increase. The spring-born Friesians were already 61 kg heavier than the Angus in October when stall feeding commenced and this difference in liveweight increased to 82 kg (30%) at slaughter. The weight advantage of Friesians compared with Angus cattle at slaughter probably accounted for the higher content of dissectable fat of Friesian carcasses. These estimates of total dissectable fat were derived from specific gravity measurements, and are not values for "excess fat trim" (usually about 10 to 14% for 18-month-old cattle).

TABLE 1: ANIMAL PERFORMANCE DATA — TRIAL 1

Breed	Slaughter Age (Months)	Average Daily Gain (kg/day)	Final (kg) L'weight	% Fat in Carcass
Friesian	18	0.769	358	30.8
Angus	18	0.688	276	29.8
Friesian	13	0.717	245	27.2

TABLE 2: BREED DIFFERENCES IN FEED CONVERSION EFFICIENCY (kg D.M./kg L.W.G.) — TRIAL 1

Period (weeks)	1-7	8-14	15-21	1-21
Experiment mean	5.3	8.4	12.2	8.7
Friesian (18 mon)-Angus	1.2*	2.1*	3.7**	2.3***
Friesian (13 mon)-Angus	0.1	— 0.6	— 3.0*	— 1.2***
Adjusted for liveweight:				
Friesian (18 mon)-Angus	0.7	— 0.4	2.6	0.9
Friesian (13 mon)-Angus	0.4	1.0	2.4	— 0.3

*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

The weight of pasture dry matter (D.M.) consumed per kg of liveweight gain (Table 2) was significantly higher for the faster growing spring-born Friesians than for the Angus steers. But the Angus steers themselves required significantly more feed per kg liveweight gain than the younger autumn-born Friesians.

It was apparent that the major factor influencing feed conversion efficiency was not the breed but the liveweight of the animal. This was largely confirmed by the absence of significant differences in conversion efficiency between breeds when mean liveweight was used in an analysis of covariance.

In order to further examine this somewhat surprising result, the 21-week stall feeding period was split into three 7-week periods covering spring, early and late summer. Overall the efficiency of feed conversion declined rapidly in each successive 7-week period but there was little apparent effect on the relative conversion efficiencies of spring-born Angus and Friesian steers. The increase in the size of the difference between these two groups was small in relation to the experiment mean, increasing from 23% in the first 7 weeks to 30% in the last period. In the case of the young Friesians, most of their improved performance, relative to the Angus, occurred in the final 7-week period.

TABLE 3: GROWTH RATE DATA — TRIAL 2

Breed	*L.W.G. (kg/day)* Winter	Summer	Whole Trial	*Carcass Wt (kg)* Initial	Final	Diff. in Weights
Friesian	0.590	0.585	0.586	75.7	190.3	114.6
Angus	0.498	0.555	0.538	69.9	181.2	111.3
Friesian-Angus	0.092**	0.030	0.048**	5.8	9.1	3.3

TABLE 4: INTAKE DATA (kg) — TRIAL 2

Breed	*D.M.* Winter	Summer	*D.O.M.* Winter	Summer	*D.O.M./100 kg L'weight* Winter
Friesian	4.91	7.13	3.11	4.18	1.44
Angus	4.30	6.53	2.73	3.86	1.35
Friesian-Angus	0.61***	0.60***	0.38***	0.32***	0.09***

$^{***}P < 0.001$

TABLE 5: FEED CONVERSION EFFICIENCIES (kg D.M./kg L.W.G.) RELATIVE TO BREED AND PERIOD OF TRIAL — TRIAL 2

Breed	*Winter Period*	*Summer Period*	*Whole Trial*
Friesian	8.7	12.3	10.9
Angus	9.7	11.8	10.8
Friesian-Angus	1.00	0.43	0.13

TABLE 6: MULTIPLE REGRESSION EQUATIONS FOR INTAKE (in kg) OF DITESTIBLE ORGANIC MATTER (y)

Breed	*Equations*	*R.*	*R.S.D.*	*R.C.V.*
Winter				
Friesian	$2.05^{***} x_1 + 0.005\ x_2 + 0.67$	0.78***	0.26	8.9
Angus	$1.94^{***} x_1 + 0.008^{**} x_2 + 0.05$	0.95***	0.18	7.1
Summer				
Friesian	$0.27\ x_1 + 0.006^{**} x_2 + 2.13$	0.65**	0.18	4.2
Angus	$1.61^{*}\ x_1 + 0.004\ x_2 + 2.00$	0.51**	0.52	6.6

x_1 = Liveweight gain (kg/day)
x_2 = Mean liveweight (kg)

$^{*}P < 0.05$; $^{**}P < 0.01$; $^{***}P < 0.001$.

TRIAL 2

The differences in growth rate between Angus and Friesian steers during the winter were similar to those recorded during the complete period of the previous trial (Table 3). In summer the difference in growth rate between breeds was non significant, but over the complete trial the Friesians grew significantly faster than the Angus steers.

Because of the selection procedures used for cattle in this trial the carcass weight differences between breeds were relatively small. Nevertheless the Friesian animals still had 5% heavier carcasses at slaughter. These results confirm previous work (*loc. cit.*) on the relative growth rates of Friesian and Angus steers.

The intake data (Table 4) demonstrate the greater appetites of the Friesian steers in comparison with the Angus. It is interesting that this increased appetite is not solely a function of increased liveweight, and that the Friesians consumed significantly ($P < 0.001$) more digestible organic matter (D.O.M.) per kg liveweight than the Angus steers.

The efficiency of feed conversion, expressed as kg D.M. consumed per kg liveweight gain, did not differ significantly between Friesian and Angus steers (Table 5). To examine further the relationships between food intake and liveweight gain, multiple regression equations were calculated to determine the apparent influence on D.O.M. intake of the observed variation in liveweight gain and mean liveweight (Table 6). No significant differences between breeds in regression coefficients were found, indicating that there was no evidence from this trial that the Friesian and Angus steers had significantly different requirements of D.O.M. for either maintenance or liveweight gain.

These conclusions are all related to feed requirements for liveweight gain, which is itself only an indication of carcass beef production. It may be argued that despite the similarities of feed requirements for liveweight gain, real differences in feed requirements for carcass weight gain, or for components of carcass weight gain might occur. This suggestion is supported by the highly significant differences in carcass specific gravity found between Friesian and Angus steers (Table 7). These suggested that the Friesian steers had 2.6% less dissectable fat, 1.8% more muscle and 0.7% more bone in their carcasses than did in the Angus.

TABLE 7: COMPOSITION OF CARCASSES FROM ANGUS AND FRIESIAN STEERS

Breed	*Specific Gravity*	*% Fat*	*% Muscle*	*% Bone*
Friesian	1.0698	29.4	56.6	14.0
Angus	1.0632	32.0	54.8	13.3
Friesian-Angus	0.0066***	— 2.6†	1.8†	0.7†

***$P < 0.001$
†Differences not analysed, as they were derived from specific gravity data.

TABLE 8: CARCASS TISSUE GROWTH DATA FOR ANGUS AND FRIESIAN STEERS

Breed	*Fat*	*Muscle*	*Bone*	*Whole Carcass*
Carcass Tissues as % of Liveweight Gain				
Friesian	20.0	32.5	7.8	60.3
Angus	22.4	31.6	7.4	61.4
Friesian-Angus	— 2.4	0.9	0.4	—1.1
kg D.M. per kg Tissue Growth				
Friesian	55.6	34.2	142.7	18.4
Angus	47.1	33.3	142.6	17.2
Friesian-Angus	8.5	0.9	0.1	1.2

Some of the breed differences in carcass composition were inherent in the stock at the start of the trials. Consequently the percentage of liveweight gain attributable to muscle and bone growth was very similar for both breeds, but the fat component was lower for the Friesians and resulted in a slightly lower percentage of carcass weight in their liveweight gains (Table 8).

These data were used to calculate the conversion efficiencies of D.M. into growth of fat, muscle and bone (Table 8). The results suggest that the two breeds were almost identical in their feed requirements for the production of muscle and bone, but that the Angus were more efficient in the production of fat — a doubtful distinction in current markets.

The present data, drawn from what were primarily feeding trials, have indicated the relative feed conversion efficiencies of Friesian and Angus steers. Some limitations of the data should be noted. In Trial 1 the numbers of cattle within each breed group (8 and 14) were small, and no two groups were truly comparable. The spring-born Friesians were 5 weeks older than the Angus steers and were 60-80 kg heavier throughout the trial. Conversely, the autumn-born Friesians were both younger and lighter than the Angus. The use of liveweight as the independent variate in a co-variance analysis went some way towards overcoming this problem but cannot be considered as a completely satisfactory solution.

In Trial 2 the numbers of animals within each breed and the length of the feeding period were about twice that for Trial 1. The selection of a heavier-than-average group of Angus cattle greatly reduced the discrepancy in liveweight between the breeds, but could also have biased the breed comparisons. These objections of differences in weight, age or selection procedure within one of the groups are, of course, inevitable when efficiency comparisons are attempted between breeds of differing growth rate and mature size and with animals within each breed.

A possible answer to this problem might be to compare Friesian and Angus cattle of different weights fed at widely different levels, and to use multiple regression analysis for the estimation of feed requirements for maintenance and liveweight gain. It would be desirable to state criteria to be met before the experiment could be considered to have adequately estimated the requirements for liveweight gain and maintenance. Such standards could be a multiple regression coefficient of 0.90 or higher, a residual standard deviation for D.O.M. intake of less than 0.20 kg, and a regression constant within the range $\pm$ 0.10 kg. The only equation presented in this paper that met these criteria was that for winter-fed Angus steers ($R = 0.95$; R.S.D. = 0.18; constant = + 0.05). The most common deficiency in the other equations was insufficient variation in liveweight gain. The use of the term liveweight$^{0.75}$ would be a desirable modification when deriving equations for animals of widely varying liveweight. It is considered most unlikely that the use of this parameter would have made any difference to the precision with which D.O.M. intake was associated with liveweight change in these trials, as liveweight differences were relatively small.

Hutton (1962) has discussed "multiple regression method" of estimating maintenance requirements and raised several theoretical objections. He has pointed out that while body surface area is related to basal metabolism it is also related to the heat disposal capacity of the body. The latter may be an important factor in the relationship between liveweight and D.O.M. intake that is not directly related to true maintenance requirements. While admitting the strength of such arguments, they are, in the writer's view, of little practical significance provided the limitations of the derived equations are acknowledged. These equations should be of real value in estimating the feed requirements of stock of differing liveweights for a range of liveweight gains, provided they are only applied to:

(a) Stock of similar liveweights and liveweight gains to those used in the experiments; and

(b) Feeds of similar type to those used in the experiments from which the equations were derived.

Meyer and Garrett (1967) point to the many pitfalls in attempting to draw conclusions from food conversion efficiency data. The worst faults have been avoided in these trials through the use of stock from similar rearing systems, and in Trial 2 by feeding all the animals *ad lib.* and by supporting the conclusions on efficiency of liveweight gain with data on the conversion of D.M. to weight gains of individual tissues.

CONCLUSIONS

The present experiments have shown that Angus steers, stall fed on pasture and roughage and slaughtered at 18 months, are likely to be as efficient converters of feed as similarly-fed Friesian steers slaughtered at the same age. This conclusion cannot necessarily be extrapolated into a grazing situation where the greater appetites of the Friesians may be associated with more efficient pasture utilization.

Further, there are other facets of beef production systems utilizing Friesian cattle which might make these systems more efficient than those using Angus cattle. If the calves are suckled by Friesian cows, the higher milk yields of these cows and their consequent potential for multiple suckling, are likely to lead to much more efficient utilization of pasture for the production of weaners.

Alternatively, if calves are early weaned and intensively fattened for 15 months from November, the outputs of beef per acre can be expected to be substantially higher than could be obtained from April-weaned Angus cattle. This would not be due to breed differences in conversion efficiency but to the lower average liveweights, and hence maintenance requirements, of the early-weaned Friesian calves. Another factor could be the better fit between animal feed requirements and pasture availability obtained from this production system.

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