PASTURE INTAKE BY HIGH VERSUS LOW NET FEED EFFICIENT ANGUS COWS

R.M. HERD[A], E.C. RICHARDSON[B], R.S. HEGARTY[A], R. WOODGATE[A], J.A. ARCHER[B], and P.F. ARTHUR[B]

[A] NSW Agriculture Beef Centre, University of New England, Armidale, NSW 2351
[B] NSW Agriculture Research Centre, Trangie, NSW 2823

SUMMARY

Pasture intake was measured in 41 lactating cows that had previously been ranked as either above average for postweaning net feed efficiency (HE), or below average (LE), when tested as young heifers on a pelleted ration. The study demonstrated a phenotypic association between the net feed efficiency of the young female and her later efficiency at pasture. High net efficient cows were 7% heavier (P<0.05), had similar subcutaneous fat stores and reared calves of similar weight to LE cows, but consumed no more feed than the LE cows. The advantage in efficiency of HE cows, when expressed as a ratio of calf weight to cow feed intake, whilst numerically large (15%), was statistically non-significant (P=0.07). That the HE cows were heavier, but no fatter than the LE cows, could imply an association of efficiency with maturity pattern.

Keywords: cow efficiency, pasture intake, alkanes

INTRODUCTION

Feed consumed by the cow herd typically represents 70% of the total feed consumed annually on beef production enterprises in southern Australia. Recent research has shown large variation in feed intake by young cattle that is independent (net) of their size and growth rate (Herd *et al*. 1997). This measure of efficiency has been termed net feed efficiency, is heritable and responds to selection (Herd *et al*. 1997). Should this variation in efficiency in young cattle also be associated with variation in efficiency when they are older, then breeding for superior net feed efficiency could reduce the feed cost for the cow herd.

However, postweaning net feed efficiency is currently assessed in confined young cattle individually fed a medium-quality pelleted ration (Herd *et al*. 1997). The relevance of this measure of efficiency to the efficiency of cows grazing extensive pasture needs to be determined. The aim of this study was to evaluate whether heifers previously tested and ranked for postweaning net feed efficiency were more or less efficient as lactating cows consuming pasture.

MATERIALS AND METHODS

Animals

The study was conducted at the NSW Agriculture Research Centre at Trangie. Fifty-six cows (three years old; second lactation) that had previously been tested and ranked for postweaning net feed efficiency were available. The 22 most efficient and 22 least efficient were selected to have their pasture intakes measured. Details of the postweaning net feed efficiency-test procedure are available in Herd *et al*. (1997). The cows and calves had been grazing an irrigated oat crop and were moved onto an ungrazed oat crop adjacent to the cattle yards, two days before insertion of intraruminal alkane capsules. The cows were in the third month of their lactation when tested in October 1996.

The cows and calves were weighed immediately off pasture, at the start of the measurement period, and again after 11, 14 and 18 days. The mean liveweight (LW) of each animal was calculated for the period. Subcutaneous fat thickness at the 12/13th rib and P8 rump site was measured by ultrasound on the cows at the start of the measurement period.

Measurement of intake and diet composition

Cows were dosed (on day= 0) with an intraruminal controlled-release device (CRD) containing 7.53 g of C32 and C36 alkane. The CRDs were supplied in two batches by Captec (NZ) Ltd, and manufactured and tested to deliver either 355 (batch 1) or 410 mg/day (batch 2) of each alkane. The expected duration of payout of alkane by the CRDs was 21 and 18 days, respectively, assuming no delay in start of release of alkane after dosing. On day 0, six cows had faecal samples taken for measurement of pre-dosing or background levels of C32 and C36 alkanes. All the cows were faecal sampled once only on each of three days (7, 11, 14). If a faecal sample could not be easily obtained from a cow, she was mustered the next day and a sample obtained. Faecal samples were taken mid-morning. Diurnal variation in the faecal alkane ratios used in calculating intake were presumed to be negligible with the synthetic alkanes being administered by CRD (Dove and Mayes 1996).

The diet consumed by the cows during the feed-intake measurement period was determined on day 11. Samples of the pasture that the cows were observed to be grazing were cut and the least-squares combination of alkane profile of the pasture species which best explained the alkane profile of the faeces calculated (Dove and Moore 1995). The concentrations of plant alkanes were adjusted for differential recoveries in faeces using assumed recoveries for C33=84% and C31=80% (Dicker *et al*. 1996), and for C29=75% and C27=70% (assuming recoveries declined by 5% units for each 2-carbon reduction in alkane chain length, extrapolated from Figure 2b in Dove and Mayes 1991).

Intake of dry matter (DM) was calculated using the formula of Dove and Mayes (1991), assuming equal recovery of the C32:C33 and C31:C32 pairs, and after adjusting faecal alkane concentrations for assumed differences in recovery. The recoveries used for dosed synthetic alkanes were 96% for C32 and C36 (Dicker et al. 1996). Faecal output was calculated as (C36 dose rate x C36 recovery)/faecal C36 concentration, and digestibility of DM as (intake minus faecal output)/intake.

The nitrogen and digestible-DM content of dried (60^{o}C) pasture components was measured *in vitro* by the Feeds Evaluation Service of the University of New England, Armidale. The alkane compositions of dried pasture samples and faeces were analysed by gas chromatography. Excessively large variation (c.v.>50%; equivalent to exceeding a 95% confidence level that is ± 100% of the mean) in dosed C36 alkane for the three faecal samples collected from each cows was taken as evidence of malfunction their CRD or interruption to normal intake. On this basis, data for three cows were excluded from the results. Differences between means for the HE and LE groups were tested using the t-statistic, computed assuming unequal variances.

RESULTS

Diet composition

The cows were observed to be eating mostly the grained-filled heads of the immature oat plants, a little of the regrowing green tops of previously grazed plants and, perhaps, a small quantity of the sparse ryegrass at ground level that was regrowing from the previous year. However, comparison of the alkane composition of these feeds with the alkane profile in faeces revealed that about one-quarter of the herbage being consumed was ryegrass, with the remainder being the grain-filled heads, and no evidence for consumption of the regrowing shoots from previously grazed oat plants.

There was no difference between the HE and LE cow groups in the proportion of grain-filled heads in the diet consumed (mean ± s.e. = 71 ± 4 % and 76 ± 2 % respectively; P=0.19). From the amounts of each pasture component being consumed, the alkane composition of the diet for each cow was calculated for subsequent use in computing each cow's intake of DM. The nitrogen, digestible DM and alkane content of the pasture components is shown in Table 1.

Table 1. Nitrogen and digestible DM content, and alkane composition, of the main components of the grazed oat pasture

	Grain-filled heads	Regrowing oat tops	Ryegrass
Nitrogen (% DM)	1.6	3.6	1.1
Digestible DM (%)	64	69	44
C27 (mg/kg DM)	11	52	57
C29 (mg/kg DM)	42	62	144
C31 (mg/kg DM)	90	64	248
C32 (mg/kg DM)	3	7	7
C33 (mg/kg DM)	12	31	50

Performance of the alkane CRDs

The mean intake of DM by all cows was 10.1 and 12.9 kg/day calculated using the C31:C32 and C33:C32 ratios respectively, and assuming similar recoveries in faeces for the alkanes in each ratio. Failure to adjust for differences in recovery can result in erroneous estimates of intake (Dicker *et al*. 1996). Intakes were recalculated using the recoveries assumed above. Mean DM intake estimated by the adjusted C31:C32 and C33:C32 ratios increased by 23 and 16%, to 12.4 and 15.0 kg/day respectively. This is in close agreement with the 20 and 15% increases predicted by Dove and Moore (1995) for the 12 and 16 percentage-unit differences in assumed alkane recoveries. The discrepancy in intake estimates between the two alkane pairs suggested imperfect adjustment for differences in recovery; the ratio of the mean of the adjusted faecal C31 and C33 values, to the adjusted C32 content, was used to recalculate intakes. The resultant mean intake by all the cows was 12.9 kg DM/day. This is close to the intake of 12.6 kg DM/day predicted by SCA (1990) for 600 kg Angus cows eating a 75% oat/25% ryegrass diet (assumed metabolisable energy content 8.8 MJ/kg DM) and gaining 0.4 kg/day (as in this study), and producing 7.5 kg/day of 3.2% fat and 8.9% solids-not-fat milk (unpublished results for similar Trangie cows).

Liveweights, DM intakes and efficiency

The HE cows were heavier than the LE cows during the intake measurement period, but no fatter (Table 2). Calves from both cow groups were, on average, the same weight and age. Although 7% heavier, the HE cows consumed no more feed DM per day than the LE cows (Table 2), and on this basis were more efficient. Efficiency is often expressed as a ratio of output/input. In this study the ratio of calf weight sustained by the cow divided by the feed intake of the cow, was calculated. During the measurement period, the HE cows sustained 15% more weight of calf per kilogram of feed eaten than did the LE cows, but this difference was not significant (P=0.07). There was no evidence that either group of cows were more able to digest the DM in their diet.

Table 2. Cow and calf liveweights, pasture intake and efficiency for lactating cows that had previously being tested for postweaning net feed efficiency and ranked as high (HE) or low (LE) net feed efficient. Values are means ± s.e.

	HE cows	LE cows	Significance[a]
Number of cows	20	21	
Cow LW (kg)	618.0 ± 16.0	577.0 ± 11.0	*
Cow rib fat (mm)	12.0 ± 0.7	11.7 ± 0.8	n.s.
Cow rump fat (mm)	15.8 ± 0.8	15.6 ± 0.8	n.s.
Calf LW (kg)	111.0 ± 4.0	104.0 ± 4.0	n.s.
Calf age at start (days)	69.0 ± 2.0	63.0 ± 3.0	n.s.
Cow DM-intake (kg/day)	12.5 ± 0.7	13.2 ± 0.7	n.s.
Calf LW / cow DM-intake (kg/kg.day)	9.3 ± 0.5	8.1 ± 0.4	n.s. (P=0.07)
DM digestibility by cow (%)	60.0 ± 2.0	62.0 ± 1.0	n.s.

[a] * Means are significantly different (P<0.05); n.s. means are not significantly different (P>0.05)

DISCUSSION

This study was in response to the question: do young heifers that rank highly for net feed efficiency in postweaning tests conducted at the Trangie Research Centre grow to become more efficient cows at pasture? The results show that this sample of phenotypically-selected HE cows were more efficient at pasture than the LE cows. The HE cows were 7% heavier, had similar subcutaneous fat stores and reared calves of similar weight to LE cows, but consumed no more feed DM than the LE cows. If the HE cows are still heavier at cull age then there would be a small economic advantage to the HE cows from the increased value of the heavier cull cow. That the HE cows were heavier, but no fatter than the LE cows, could imply an association of efficiency with maturity pattern.

The advantage in efficiency of HE cows, when expressed as a ratio of calf weight to cow feed intake, whilst numerically large (15%), was statistically non-significant (P=0.07). Strictly, this means there was no conclusive demonstration of an advantage in this important production ratio. However, the combination of errors incurred using an indirect measure of intake, measurement of intake and LWs over a short period of time (8 and 28 days respectively) and their combination into a ratio, probably increased variation in this measure of efficiency such that a difference in efficiency of this magnitude could not be demonstrated statistically without measuring a larger sample of cows. There was certainly no evidence that the HE cows and calves were less efficient than the LE cows and calves.

The use of alkane technology to estimate diet composition revealed that the cows were consuming a diet different to the one judged by simple observation. Failure to recognise this in studies at pasture, and to account for the individual diet selection of each cow, could result in erroneous values for herbage alkane concentration being used for calculation of intake. The discrepancy in intake estimates between the adjusted C31:C32 and C33:C32 ratios suggested imperfect adjustment for differences in recovery. The ability by the cows to digest DM, as calculated from the alkane data, was slightly lower than the digestible DM content reported for the oat pasture, but not as low as might be expected for a diet apparently with one-quarter as low-digestible ryegrass. The assumed values used for recoveries came from other experiments. Their determination for the diets under study is important to both determination of diet composition and to measurement of intake. These considerations, plus the c.v. of the release rate for each batch of CRDs (6 and 9% for those used here), add to the error in measurement of intake by individual animals. They are unlikely to be a source of bias so that alkanes and CRDs remain a useful tool to compare the intake by groups of cattle.

This study has demonstrated a phenotypic association between the postweaning net feed efficiency of the young female and her later efficiency at pasture. The advantage may be as small as an improvement in the cull value of the heavier HE cow with no increase in feed eaten, but could include increased weight of calf per unit of feed eaten by the HE cow, although the evidence for the latter was inconclusive. Breeding young cattle for improved net feed efficiency has been shown to produce improvements in feed conversion ratio, and perhaps yield, in yearling steers being fed in a feedlot for slaughter (Richardson *et al*. 1998). Demonstration that selection for improved postweaning net feed efficiency will improve the efficiency of cows, and measurement of the phenotypic and genetic correlation with other important production traits continues at Trangie.

ACKNOWLEDGMENTS

We thank S. Sinclair for the alkane analyses and J. Wright, T. Snelgar, D. Mula and S. George for their assistance. This work was funded by NSW Agriculture and the Meat Research Corporation.

REFERENCES

DICKER, R.W., HERD, R.M. and ODDY, V.H. (1996). *Proc. Nutr. Soc. Aust*. **20**, 107.

DOVE, H. and MOORE, A.D. (1995). *Aust. J. Agric. Res*. **46**, 1535-44.

DOVE, H. and MAYES, R.W. (1991). *Aust. J. Agric. Res*. **42**, 913-52.

DOVE, H. and MAYES, R.W. (1996). *J. Nutr*. **126**, 13-26.

HERD, R.M., ARCHER, J.A., ARTHUR, P.F., RICHARDSON, E.C., WRIGHT, J.H., DIBLEY, K.C.P. and BURTON, D.A. (1997). *Proc. Assoc. Advmt. Anim. Breed. Genet*. **12**, 742-5.

RICHARDSON, E.C., HERD, R.M., ARCHER, J.A., WOODGATE, R.T. and ARTHUR, P.F. (1998). *Anim. Prod. Aust.* **22**, 213.

SCA (1990). 'Feeding Standards for Australian Livestock: Ruminants'. (Standing Committee on Agriculture and CSIRO: Melbourne).