

POTENTIAL TO DOUBLE THE NUMBER OF CATTLE TESTED FOR RESIDUAL FEED INTAKE

K. A. Donoghue¹, P. F. Arthur² and R. M. Herd³

Cooperative Research Centre for Beef Genetic Technologies

¹NSW Department of Primary Industries, Agricultural Research Centre, Trangie, NSW 2823

²NSW Department of Primary Industries, Elizabeth Macarthur Agricultural Institute, Camden, NSW, 2570

³NSW Department of Primary Industries, Beef Industry Centre, Armidale, NSW 2351

SUMMARY

The effect of foregoing daily feed intake records when cattle were rotated weekly between pens with or without functional feed intake recorders on the estimate of residual feed intake over a 70-day test period was investigated. Over the test period, animals (n=48) were rotated on a week-on/week-off basis from recording feeders (week-on) to non-recording feeders (week-off). In addition, weekly weights were taken on all animals. There was no evidence of re-adaptation to feeders during recording week or significant differences in average daily gain between the recording and non-recording weeks. Comparisons between this test and previous tests where feed intake was continuously recorded indicated no significant differences in the amount of variation in feed intake explained by average daily gain and metabolic weight. These results indicate that a week-on/week-off strategy, when implemented as in this study, has potential to double the number of animals measured through a feed intake recording system without comprising data collected for RFI computation. Genetic improvement programs which include feed efficiency in their breeding objective will benefit from increased number of records available.

INTRODUCTION

Residual feed intake (RFI) is the amount of feed eaten, net of the requirements for maintenance and production. Inclusion of this trait in selection indices allows beef producers to make genetic improvement in feed efficiency. While previous studies have indicated that a test length of 35 days is adequate to measure feed intake, a longer test period (70 days) is required to accurately measure growth; thus the recommended test length to measure RFI is 70 days (Archer *et al.* 1997; Exton 2001). The number of animals that can undergo a continuously recorded 70-day feed intake test is often limited by the capacity of the feed intake system, and ways to increase the number of animals tested are keenly sought. One such possibility is the periodic recording of daily feed intake (DFI) through a rotation of animals on a week-on/week-off basis, such that animals have DFI records for half of the test period (35 days), but still have growth records for the full 70 days. This strategy would double the number of animals that could be measured through a feed intake recording system and would increase the amount of information available for genetic improvement programs for feed efficiency. The objective of this study was to examine the impact of foregoing DFI records when cattle were rotated on a week-on/week-off from feed intake recorders on the estimate of RFI over a 70-day test period.

MATERIALS AND METHODS

Data. Forty-eight Angus heifers underwent a postweaning RFI test at the Agricultural Research Centre, Trangie, NSW. These heifers were born in 2007 and were part of the Trangie RFI divergent selection lines. Details of the postweaning test procedure are given in Arthur *et al.* (2001a) and establishment of the divergent selection lines in Arthur *et al.* (2001b). The heifers

were randomly split into four pens with 12 heifers in each pen. Two of the pens each contained an automated feed intake recorder (described by Bindon 2001) which recorded individual feed intakes. The other two pens each contained an identical but disabled feed intake recorder. Heifers were rotated on a week-on/week-off basis between pens with recording feeders (week-on) and pens with non-recording feeders (week-off) such that a total of 35 days of individual feed intakes were available. Heifers were weighed weekly for the duration of the test.

After an adjustment period of 21 days, the heifers commenced a test of 70 days duration. A pelleted diet composed of 70% lucerne hay and 30% grain, with approximately 10.5MJ metabolisable energy (ME) per kg dry matter and 17% crude protein was fed. All heifers were given *ad libitum* access to this feed, and a daily allowance of 0.5kg/animal of wheaten straw (approximately 5.2MJ ME /kg dry matter) was provided.

Statistical analysis. Growth of the heifers was modelled by linear regression of weekly weight against time with the regression coefficients used as the average daily gain (ADG) for each animal (SAS Institute 2003). A separate regression was fitted for each animal. The weight of each animal at the mid-point of the test period raised to the power 0.75 (metabolic mid-weight) and ADG were used in a multiple regression with daily feed intake (DFI) as the dependent variable. RFI was equated to the residual error term in the model.

Tests of significance for ADG in recording and non-recording weeks were undertaken to examine whether heifers were experiencing different rates of gain in recording vs. non-recording weeks. For this test, individual ADG were averaged over recording and non-recording weeks, and a pair-wise t-test of significance was calculated. Tests of significance for DFI during days of recording weeks were undertaken to examine whether heifers were experiencing re-adaptation to the recording feeders; that is, eating significantly less feed when first re-introduced to the recording feeders. For these tests, DFI on days 1 to 7 of each recording week were averaged for every animal. Pair-wise t-tests of significance were calculated for DFI on day 1 vs. days 2-7; days 1-2 vs. days 3-7 ; and days 1-3 vs. days 4-7.

The number of heifers with low feed intake on each day throughout the test was also examined in order to observe whether re-adaptation to the recording feeders was occurring. An animal was defined as having a low feed intake on a particular day if their DFI was lower than 1.5% of their weekly liveweight. An adjusted R^2 value was obtained from the regression of ADG and metabolic mid-weight on DFI in this study, and was compared with values from recent tests in the amount of variation in DFI explained by ADG and MWT.

RESULTS AND DISCUSSION

Data. Descriptive statistics of the data are contained in Table 1. Significant variation in the heifers was observed for all traits, including ADG (range of 1.1 kg/day) and RFI (range of 4.5 kg/day).

Table 1. Descriptive statistics of the data

| Trait | Mean | SD | Minimum | Maximum |
|----------------------------|-------|------|---------|---------|
| Start weight, kg | 304 | 36 | 230 | 417 |
| End weight, kg | 401 | 44 | 300 | 539 |
| Metabolic mid-weight, kg | 72 | 5.8 | 59 | 90 |
| Daily feed intake, kg | 10.54 | 1.56 | 7.95 | 14.63 |
| Average daily gain, kg/d | 1.42 | 0.22 | 0.91 | 2.01 |
| Residual feed intake, kg/d | -0.11 | 1.07 | -2.03 | 2.48 |

ADG did not differ significantly ($P = 0.89$) between recording (1.50 kg/day) and non-recording (1.51 kg/day) weeks. This result indicates that heifers performed similarly with respect to weight gain during recording and non-recording periods, and that the method of periodic recording of feed intake had no impact on weight gain throughout the test used in this study.

There was no evidence of significant differences ($P > 0.05$) between individual DFI early in recording weeks (days 1, 2 or 3) and individual DFI in the second half of the recording weeks (Table 2). This result indicates that heifers were not experiencing re-adaptation each time they rotated to the recording feeders, and that the method of periodic recording of feed intake had no impact on DFI throughout the test. Further confirmation of this finding is evident in Figure 1, where there was no evidence of greater number of animals having low feed intake on the first day of each recording week (Days 1, 8, 15, 22 and 29) compared to other days throughout the test.

Table 2. The t-tests of significance for difference in feed intake between days of week

| Comparison | P value |
|-----------------------|---------|
| Day 1 vs. Days 2-7 | 0.14 |
| Days 1-2 vs. Days 3-7 | 0.22 |
| Days 1-3 vs. Days 4-7 | 0.38 |

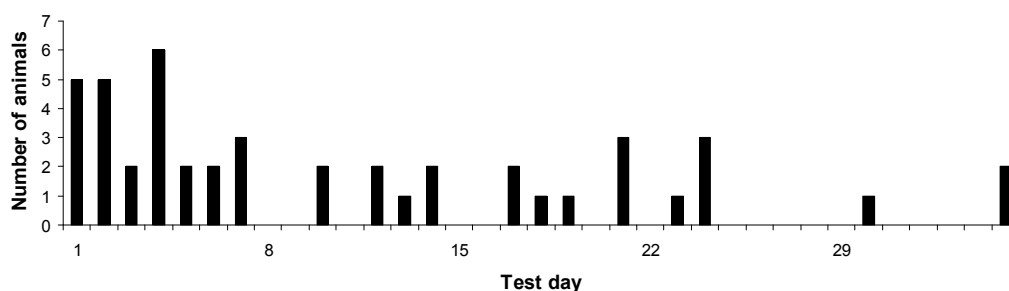


Figure 1. Number of animals with feed intake below 1.5% of liveweight

These results are in contrast to a study in pigs undergoing a similar week-on/week-off feed intake test (Schulze *et al.* 2001) where animals experienced “re-adaptation” to the feeders each recording week. This re-adaptation was manifested such that the periodically recorded pigs had a substantially higher percentage of animals with low feed consumption at the beginning of each recording week, in comparison with continuously recorded pigs. In our study, the only difference between the recording and non-recording feeders was the absence of a small electronic control box on the back (and out of view of the animal) of the non-recording feeders. Thus, heifers experienced a very similar feeding environment in recording and non-recording weeks. In the pig study, however, the feeding environments between recording (electronic feeders) and non-recording (conventional feed dispenser) weeks were quite different (Schulze *et al.* 2001), which may explain the different findings.

The amount of variation in DFI explained by ADG and metabolic mid-weight in this test (0.54; see Table 3) was similar to that for other recent RFI tests in which animals were continuously recorded for DFI (0.46-0.66; see Table 3). This would indicate that periodic recording of DFI did not compromise data collected for RFI computation, and that the amount of variation in RFI

explained by ADG and DFI was similar to that observed in studies where DFI was recorded continuously.

Table 3. Comparison of adjusted R² values for RFI tests

| Animal source | Year of test | Number of animals | Adjusted R ² |
|------------------|--------------|-------------------|-------------------------|
| Trangie bulls | 2000 | 89 | 0.63 |
| Trangie heifers | 2000 | 92 | 0.46 |
| Industry steers | 2007 | 35 | 0.66 |
| Industry heifers | 2007 | 23 | 0.51 |
| Industry bulls | 2007 | 37 | 0.64 |
| Trangie bulls | 2008 | 102 | 0.59 |
| This study | 2008 | 48 | 0.54 |

CONCLUSIONS

Foregoing daily feed intake records when cattle were rotated on a week-on/week-off basis between pens with functional and non-functional feed intake recorders had no impact on the estimate of RFI over a 70-day test period. There was no evidence of re-adaptation to feeders during recording weeks or for significant differences in ADG between the recording and non-recording weeks. These results indicate a week-on/week-off strategy, when implemented as in this study, has potential to double the number of animals measured through a feed intake recording system without comprising data collected for RFI computation. Genetic improvement programs including feed efficiency in their breeding objective would benefit from the increased amount of information available on the trait.

ACKNOWLEDGMENTS

This work was funded by the Cooperative Research Centre for Beef Genetic Technologies. The capable assistance of D. Mula, K. Dibley and T. Snelgar is gratefully acknowledged.

REFERENCES

- Archer, J.A., Arthur, P.F., Herd, R.M., Parnell, P.F. and Pitchford, W.S. (1997) *J. Anim. Sci.* **75**: 2024.
- Arthur, P.F., Archer, J.A., Johnston, D.J., Herd, R.M., Richardson, E.C. and Parnell, P.F. (2001a) *J. Anim. Sci.* **79**: 2805.
- Arthur, P. F., Archer, J.A., Herd, R.M. and Melville, G.J. (2001b) *Proc. Assoc. Advmt. Anim. Breed. Genet.* **14**: 135.
- Bindon, B.M. (2001) *Aust. J. Exp. Ag.* **41**:843
- Exton, S. (2001) Testing beef cattle for net feed efficiency – standards manual. Edition March 2001. Performance Beef Breeders Association, Armidale, NSW.
- SAS Institute (2003). ‘ONLINE Documentation for SAS/STAT Procedures.’ (SAS Institute: Carey, NC.)
- Schulze, V., Roehe, R., Looft, H. and Kalm, E. (2001) *J. Anim. Breed. Genet.* **118**:403.