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Australian Journal of Experimental Agriculture

Volume 37, 1997

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Standing Committee on Agriculture and Resource Management (SCARM)

Australian Journal of Experimental Agriculture, 1997, **37**, 407–11

Relationships between temperament and growth in a feedlot and commercial carcass traits of *Bos indicus* crossbreds

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Summary. Two cohorts of *Bos indicus* crossbreds were studied to determine the relationships between temperament and growth in a feedlot and commercial carcass characteristics. Prior to entry to the feedlot, one cohort received intensive, short-term training at weaning but minimal handling before and after weaning, while the second cohort received similar training at weaning and also experienced a 4-month period of relatively intense handling immediately before entering the feedlot. Both cohorts entered the feedlot at similar ages. Temperament was recorded as the animal's flight speed, which is the time taken for the animal to cover 1.7 m after leaving a weighing crush, with fast times indicating animals that have poor temperaments.

Average flight speed scores of animals in the 2 cohorts differed substantially, with 51 and 12% of animals in cohorts 1 and 2 respectively having fast flight speed scores. Conversely, 23 and 69% of animals in cohorts 1 and 2 respectively had slow flight speed scores and could therefore be regarded as docile. In the first cohort, animals with slow flight speeds gained weight more rapidly ($P<0.05$) to achieve heavier slaughter and carcass weights ($P<0.05$) than animals with fast flight speeds. The relationship between flight speed and growth in the feedlot in the second cohort was not significant, although animals with the fastest flight speeds in that cohort had the lowest liveweight gains. Docile animals in both cohorts had comparable liveweight gains in the feedlot. These results suggest that animals with slow flight speed scores (good temperaments) may grow faster in a feedlot than animals with faster flight speed scores (poorer temperaments), regardless of whether the favourable scores result from intensive, long-term handling or because the animals are naturally docile. There was no relationship in either experiment between flight speed and fat thickness or carcass bruising, when bruising was scored simply as presence or absence of bruising. A negative relationship was evident between flight speed score and dressing percentage in the second cohort ($P<0.05$). The relationship between flight speed and dressing percentage was not significant in the first cohort.

It is suggested that feedlot operators could select potential feedlot animals on the basis of temperament before entry to the feedlot to improve performance in the feedlot.

Introduction

In northern Australia, more than 80% of beef cattle now have at least some component of *Bos indicus* (Anon. 1985). Producers have long recognised, and scientists have been able to quantify that *Bos indicus* are less docile than *Bos taurus* (Hearnshaw *et al*. 1979; Elder *et al.* 1980; Fordyce *et al*. 1982; Burrow 1997).

Early work by Tulloh (1961) indicated a favourable relationship between growth rate and temperament in *Bos taurus* steers and heifers grazed at pasture. This finding is supported by the reports of Fordyce *et al*. (1985, 1988*a*). The study of Fordyce *et al*. (1985) found that bruising of the carcass was not related to temperament in well handled, relatively quiet *Bos indicus*-cross steers under paddock conditions, although temperamental animals had the highest bruising scores and docile animals the lowest. In a further study though, Fordyce *et al*. (1988*b*) reported that for paddock reared Brahman-cross and Shorthorn steers and cows, estimated bruise trim per carcass increased by about 0.3 kg per unit increase in temperament score ($P<0.05$). On average, this equated to a difference of about 1.5 kg bruise trim per carcass between cattle with the highest and lowest temperament scores. In the same study, meat was less tender ($P<0.05$) for animals with the worst temperament scores.

Recently there has been an increase in the number of trade steers from northern Australia finished in feedlots. In feedlots, animals are unable to avoid human contact and it is possible that relationships between growth,

10.1071/EA96148

carcass quality and temperament could be more marked than under paddock conditions. This would disadvantage *Bos indicus*-derived cattle reared in northern Australia. However, it has been suggested that intensive handling of young animals will improve their temperament (Fordyce *et al.* 1985). The early-life temperament of young *Bos indicus* crossbreds that are later finished in a feedlot may therefore not be important in affecting feedlot performance if the intensive handling received in the feedlot overrides any relationship between growth and temperament.

This paper reports the relationship between temperament and liveweight, liveweight gain and commercial carcass characteristics of young *Bos indicus* crossbred steers and heifers initially reared at pasture but subsequently finished in a feedlot.

Materials and methods

Experimental animals and management

As part of an experiment to evaluate different feedlot rations, 2 groups of nominally 5/8 *Bos indicus*, 3/8 *Bos taurus* (mainly Brahman x Shorthorn) steers and heifers bred at Swan's Lagoon Research Station in North Queensland were transferred to a feedlot near Brisbane. These experimental animals were derived from multiple sire joining groups and hence no pedigree information was available.

The first experimental group comprised 96 heifers that were born during the 1987–88 calving period and weaned in April or August 1988 at 3–10 months of age. They were transferred to the feedlot from Swan's Lagoon in March 1989 and immediately entered the feedlot. This group is defined as the 1989 cohort. They were slaughtered in July after 129 days in the feedlot. At weaning, these heifers were held in yards and fed hay for about 10 days. During that time, they were worked through the yards by stockmen on foot and also 'tailed out' of the yards by horsemen on several occasions. They received minimal handling before and after the weaning period.

The second experimental group of 60 steers and 59 heifers were born in the 1988–89 calving period and weaned in May or July 1989 at 5–8 months of age. At weaning, they received similar training to the first experimental group (held in yards and fed hay, worked through the yards by stockmen on foot and 'tailed out' over a 10-day period.) They were transferred to Brisbane in October 1989 and entered the feedlot in February 1990. This group is defined as the 1990 cohort. From October 1989 to February 1990, the animals grazed pasture in small paddocks near the feedlot and were mustered and rotated between paddocks on a regular basis. During this period, they were mustered into yards and liveweights were recorded each month. As a result of this regular handling, the animals were accustomed to people, tractors, cars and city noises by the time they entered the feedlot in February 1990. Heifers from the 1990 cohort were slaughtered after 87 days and the steers after 96 days in the feedlot.

In the feedlot, animals from both cohorts were allocated at random within sexes (1990 cohort only) into heavy, medium and light weight groups to 4 feedlot ration treatments. There were 8 animals per pen in the 1989 cohort and 5 animals per pen in the 1990 cohort. The feedlot rations comprised about 70% barley or sorghum grain (either cracked or steam-flaked) and 30% chopped lucerne hay that had been premixed with the grain. Details of the feedlot ration treatments are the subject of a separate report (T. Plasto and R. D. Dillon unpublished data) and no further description of the treatments is given here.

Liveweights were recorded each week for the duration of both experiments. Flight speed was also measured at time of weighing for the first 8 and 11 weeks of experiments 1 and 2 respectively, according to the method of Burrow *et al.* (1988). Flight speed is the electronically recorded time (in hundredths of a second) taken for an animal to cover 1.7 m after leaving a weighing crush and is a measurement of temperament of that animal. Fast flight speeds (i.e. low flight speed scores or rapid exit from the crush) indicate animals with poor temperaments.

The animals were slaughtered when the majority had achieved liveweights that were predicted to produce carcasses of 160–200 kg with a subcutaneous fat cover at the P8 rump site in the range of 5–9 mm. By Aus-Meat standards, carcasses with these specifications are suitable for the domestic trade market. At slaughter, carcass weight and fat depth at the P8 rump site were recorded. Dressing percentage was calculated as the ratio of carcass weight to fasted final liveweight. Bruising was recorded for all the 1989 cohort and the heifer portion of the 1990 cohort as a simple yes/no option, with no description being given of the extent of bruising.

Statistical analyses

Nine and 12 flight speed measurements were recorded on the 1989 and 1990 cohorts respectively. Both the repeatability of, and correlations between, flight speed measurements were calculated. Repeatability of flight speed was estimated using mixed model least squares procedures (Harvey 1987). Preliminary analyses within cohorts indicated that neither feedlot ration nor sex (within the 1990 cohort) had a significant effect on flight speed measurements. Therefore a single repeatability model was fitted, with animal treated as a random effect and cohort/replicate weight group combined as the only fixed effect. The repeatability of flight speed was estimated to be 0.88 with a standard error (calculated according to the method outlined by Becker 1967) of ± 0.01, indicating that only small increases in accuracy could be expected through use of repeated measures of flight speed. Correlations between the first 5 measures of flight speed were similar in both years and ranged from 0.60 to 0.78. Correlations between the first 5 measures and subsequent measures were lower. On the basis of these repeatability and correlation estimates, the relationship between flight speed and performance in the feedlot was evaluated using the mean of the first 5 flight speed scores. These mean scores were categorised into intervals of 0.10 s ranging from fast (low amount of time to cover 1.7 m, indicating poor temperament) to slow (high amount of time to cover 1.7 m, indicating good temperament).

Distributions of mean flight speed scores were normalised using a $\log_{10}$ (score) transformation. Transformation of flight speed scores did not affect the statistical significance of the results, so results from non-transformed data are presented herein, with levels of significance applying to transformed data.

Data were analysed within cohorts by least squares methods to determine the effects of weight group, feedlot ration, sex (for the 1990 cohort) and flight speed category on initial and final liveweights, daily liveweight gain in the feedlot, carcass weight, dressing percentage and fat thickness. Bruising was also included in the model as a dependent variable where data were available. First order interactions were initially fitted to the model and subsequently removed if found to be not significant (P>0.05). In separate analyses, flight speed was also fitted as a linear and quadratic covariate to the same models within cohorts, with weight group, feedlot ration and sex (for the 1990 cohort) fitted as fixed effects. The quadratic regression was found to be not significant (P>0.05) for both cohorts and was therefore removed from final analyses.

Results

The relationship between flight speed (fitted as either a fixed effect within categories or as a covariate) and initial and final liveweights in the feedlot and liveweight gain, carcass weight, dressing percentage, fat thickness and bruising are shown for the 1989 and 1990 cohorts in Tables 1 and 2 respectively. Table 2 also shows the effect of sex on these variables in the 1990 cohort. Flight speed was significantly (P<0.05) related to daily liveweight gain, final weight and carcass weight in the 1989 cohort but not in the 1990 cohort. Flight speed was not related (P>0.05) to initial liveweight, subcutaneous fat thickness or presence of bruising in either cohort. When flight speed was fitted as a covariate within the 1990 cohort, there was a significant negative relationship (P<0.01) between flight speed and dressing percentage, with the difference in dressing percentage between the fastest and slowest group being 1.8% (52.8 *v*. 54.6%; see Table 2). There was no relationship (P>0.05) between flight speed and dressing percentage in the 1989 cohort.

Feedlot ration and the interaction of feedlot ration with all other variables was not significant (P>0.05) for liveweights, liveweight gains and for commercial carcass characteristics in either cohort. Because of the way the animals were allocated, weight group had a significant (P<0.001) effect on initial weight, final weight and carcass weight in both cohorts. However, weight group was not related to liveweight gains, dressing percentage, fat thickness or bruising. All interactions with weight group were also not significant.

Within the 1990 cohort, heifers were initially heavier than steers (230 *v*. 216 kg; P<0.001). In the feedlot though, steers gained more rapidly than heifers (P<0.01) resulting in slightly heavier final liveweights (P<0.10) and heavier carcass weights (P<0.05). Steer carcasses also had a higher dressing percentage (P<0.05) and were markedly leaner (P<0.001) than heifer carcasses.

Discussion

There was a very marked difference in the average flight speeds of animals in the 2 cohorts. A previous study (Burrow 1991) showed that animals having a flight speed score <0.7 s could generally be regarded as temperamental, while animals having a flight speed score ≥0.9 s could be considered docile. In that study, docile animals were less responsive to training than animals with lower flight speed scores. From Tables 1

Table 1. Relationships between flight speed (fitted as either a fixed effect within categories or as a covariate) and initial and final liveweights in the feedlot, daily liveweight gain and commercial carcass characteristics of the 1989 cohort

	No. of animals	Initial liveweight (kg)	Liveweight gain (kg/day)	Final liveweight (kg)	Carcass weight (kg)	Dressing percentage (%)	Fat thickness (mm)	Bruising score[A]
Flight speed category (s)								
<0.50	14	197	0.79	297	167	56.0	8.6	1.08
0.50–0.59	14	199	0.75	295	164	55.7	7.9	1.20
0.60–0.69	21	195	0.87	307	168	54.8	8.4	1.10
0.70–0.79	15	202	0.93	321	177	55.1	9.3	1.13
0.80–0.89	10	195	0.84	303	167	55.0	7.0	1.40
0.90–0.99	9	194	0.92	312	170	54.4	10.2	1.20
1.00–1.09	5	202	0.93	323	176	54.4	8.3	1.04
1.10–1.19	4	200	0.91	316	174	55.0	8.9	1.23
≥1.20	4	203	1.13	346	195	56.5	10.5	0.94
Significance								
Fixed effect within category		n.s.	P<0.05	P<0.05	P<0.05	n.s.	n.s.	n.s.
Covariate		n.s.	P<0.001	P<0.01	P<0.01	n.s.	n.s.	n.s.
Regression coefficient[B]	96	3.37	0.29	40.45	20.13	–0.82	2.26	–0.01
Overall mean ± s.e.	96	198 ± 1.5	0.89 ± 0.02	313 ± 3.1	173 ± 1.8	55.2 ± 0.2	8.8 ± 0.5	1.15 ± 0.04

[A] Bruise score : 1, no bruising; 2, bruise trim.
[B] The regression coefficient is the slope of the relationship between flight speed and each of the traits.

and 2, it can be calculated that 51% of the 1989 cohort and 12% of the 1990 cohort had flight speed scores <0.7 s. Conversely, 69% of the 1990 cohort and 23% of the 1989 cohort had flight speed scores ≥0.9 s. It is therefore probable that the extended period of intensive handling received by the 1990 cohort before entry to the feedlot resulted in a significant lowering of their flight speed scores. This is in agreement with the findings of Boissy and Bouissou (1988) who demonstrated that intensive, long-term (3–6 months) periods of handling effectively improved temperament scores of dairy cattle relative to non-handled controls. It is also probable that the short-term, intensive training at weaning received by the 1989 cohort was less effective than long-term, intensive handling in modifying temperament scores, in agreement with the reports of AMRC (1988) and Burrow (1991) for beef cattle and for other livestock species as reviewed by Burrow (1997).

There were also marked differences in average liveweight gains in the feedlot for the 2 cohorts (0.89 *v.* 1.08 kg/day for the 1989 and 1990 cohorts respectively; see Tables 1 and 2). Some of these differences may have been due to transportation stress and lack of acclimatisation to an urban environment in the 1989 cohort, which was transferred directly from Swan's Lagoon to the feedlot. However, from Tables 1 and 2, liveweight gains of docile animals (those with slow flight speeds) in the 1989 cohort were comparable with liveweight gains of docile animals in the 1990 cohort. This is even more evident when liveweight gains of the 1989 cohort (all heifers) over the first 90 days in the feedlot are compared with the heifer portion of the 1990 cohort over the 87 days they spent in the feedlot. Mean liveweight gains for the heifers over the comparable time frame were 0.93 and 1.02 kg/day for the 1989 and 1990 heifers respectively, with ranking of performance of 1989 heifers within flight speed category similar to those shown in Table 1. Also, even though the differences were small and statistically not significant, the temperamental animals in the 1990 cohort (those with fast flight speeds) had the lowest liveweight gains (Table 2). These results suggest that docile animals (those with slow flight speed scores) may grow faster in a feedlot than temperamental animals (those with fast flight speed scores), regardless of whether the slow flight speed scores result from intensive, long-term handling or because the animals are naturally docile. It is highly probable that the higher growth rate of slow animals results from an increased feed intake, although the probability that the faster animals may partition nutrients differently by using more energy in avoidance-type behaviour should not be ignored. Further studies would

Table 2. Relationships between flight speed (fitted as either a fixed effect within categories or as a covariate), sex and initial and final liveweights in the feedlot, daily liveweight gain and commercial carcass characteristics of the 1990 cohort

	No. of animals	Initial liveweight (kg)	Liveweight gain (kg/day)	Final liveweight (kg)	Carcass weight (kg)	Dressing percentage (%)	Fat thickness (mm)	Bruising score[A]
Flight speed category (s)								
<0.70	14	225	1.02	319	174	54.6	6.7	1.22
0.70–0.79	12	225	1.10	326	176	53.9	6.8	1.10
0.80–0.89	11	218	1.08	318	170	53.3	7.7	1.34
0.90–0.99	16	219	1.06	316	169	53.6	5.7	1.07
1.00–1.09	12	220	1.04	317	172	54.3	7.5	0.95
1.10–1.19	11	220	1.14	324	172	53.2	8.2	1.04
1.20–1.29	15	225	1.12	328	176	53.6	7.5	1.25
1.30–1.39	8	226	1.06	322	168	53.1	6.6	1.40
1.40–1.49	5	223	1.06	320	170	53.1	9.0	0.93
≥1.50	15	224	1.14	328	174	52.8	7.3	1.21
Significance								
Fixed effect within category		n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Covariate		n.s.	n.s.	n.s.	n.s.	$P<0.01$	n.s.	n.s.
Regression coefficient[B]	119	1.14	0.08	8.33	–0.40	–1.52	0.70	–0.03
Sex								
Steer	60	216	1.14	325	176	53.9	5.8	n.m.
Heifer	59	230	1.02	319	170	53.2	8.8	1.15
Significance		$P<0.001$	$P<0.01$	n.s.	$P<0.05$	$P<0.05$	$P<0.001$	—
Overall mean ± s.e.	119	222 ± 1.2	1.08 ± 0.02	322 ± 2.0	172 ± 1.2	53.6 ± 0.1	7.3 ± 0.3	1.15 ± 0.07

[A] Bruise score: 1, no bruising; 2, bruise trim. Only the heifer portion (n = 59) was scored for bruising.
[B] The regression coefficient is the slope of the relationship between flight speed and each of the other traits. n.m., not measured.

be required to determine exactly why temperamental animals perform poorly in a feedlot when compared with their more docile contemporaries, and also to determine whether there is a genetic component to the relationship.

Studies investigating the effects of temperament on carcass bruising have been inconclusive. Fordyce *et al*. (1985) found no relationship between temperament and carcass bruising in a group of relatively quiet steers, but later reported a significant increase in bruise trim per carcass for every increase in 1 unit of temperament score in less docile animals (Fordyce *et al.* 1988*b*). From those results, it could be expected that in our study there would be more bruising in the less docile 1989 cohort. In fact, there were slightly more carcasses that showed some bruising in the 1990 cohort (19.0 *v*. 15.6% for the 1990 and 1989 groups respectively, with the differences being statistically not significant). As these animals were all hornless, mixing of horned and hornless cattle before slaughter would not explain these results (Shaw *et al*. 1976). It may be possible that rather than bruising more themselves, temperamental animals may cause more bruising in other animals, including those with good temperaments, as suggested by Fordyce *et al*. (1988*b*). However, the method of scoring bruising in this experiment simply as the presence or absence of bruising did not allow relationships between weight of bruise trim and flight speed to be properly calculated. Further studies would be required to determine the relationship between temperament and bruising.

Commercial implications

In the past, feedlot operators have suggested that *Bos indicus* genotypes and their crosses are 'too nervous' to perform well in a feedlot. These results clearly indicate that *Bos indicus* crossbreds can perform creditably in a feedlot, although animals with good temperaments may grow faster than animals with poor temperaments, regardless of whether the good temperaments result from intensive, long-term handling of animals or because the animals are naturally docile. Whether extended periods of intensive training can be economically justified in most commercial operations is debatable. However, it is suggested that potential feedlot animals could be selected on the basis of a measure of temperament before entry to the feedlot.

If flight speed is used as a selection tool, it is recommended that ideally, such selection should be based on an average of 2 or 3 flight speed scores. Even though the repeatability of flight speed measurements was very high in this experiment, the correlation between successive measurements was not consistent.

Acknowledgments

Sincere thanks are due to Tony Plasto and John Connell for assistance with administration of the experiment.

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Received 26 November 1996, accepted 11 March 1997