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The effect of yard weaning and contact with humans on behavioural reactivity and liveweight gain of beef breed calves

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Abstract

Yard weaning of beef-breed calves is growing in popularity in New Zealand as a way of improving ease of handling, but there is little scientific literature regarding the practice. This experiment examined the effects of yard weaning versus paddock weaning with and without human contact on liveweight gain and behaviour. Paddock-weaned calves lost more live weight in the first seven days after weaning (-1.19 ± 0.17 kg/d versus -0.60 ± 0.16 kg/d; P=0.01) than yard-weaned calves but live weight was similar between treatments 42 days after weaning (D42). Yard-weaned calves tended to be less reactive than paddock-weaned calves on D7 (2.16 ± 0.28 versus 2.92 ± 0.33; P= 0.07, where one is least reactive and five is most reactive), but there were no differences in reactivity on D42. Faecal corticosterone concentrations were similar between weaning location, however, calves with minimal human contact had higher faecal corticosterone concentrations 48 hours after weaning than did calves with daily human contact (27.6 ± 2.11 ng/ml versus 18.6 ± 2.11 ng/ml; P<0.01), regardless of location. There were short-term advantages in live weight and heart rate associated with yard weaning of beef-breed calves, but these did not persist to D42.

Keywords Calves; weaning; temperament; yard weaning; human contact

Introduction

Yard weaning involves keeping calves confined in yards for one to two weeks directly after weaning from their dams, with daily human contact and feeding. In comparison, conventional weaning involves returning newly-separated calves to paddocks. Fell et al. (1998) showed that yard-weaned calves had greater growth rates when they were finished in high-input feedlot systems in Australia. The same method has been applied in New Zealand pasture-based systems with evidence from industry that yard weaning increased growth rates (10 kg gain over 6.5 days versus 0.5 kg for conventionally weaned calves), and reduced behavioural reactivity, making cattle easier to manage throughout their lifetime (Beef + Lamb New Zealand, 2012). It is not clear from these field trials whether it was enclosure in the yards or enforced contact with people that contributed to the reported improvements.

Subjective scores of behaviour (crush score) and objective measures of exit speed from a crush have been reported to correlate with heart rate and cortisol concentration in blood in response to stress (Grandin 1997; Curley et al. 2006, Vetters et al. 2013). Flight score and number of steps taken in a crush are also reliable methods to assess behavioural reactivity in cattle (Lanier et al. 2000).

Lower reactivity (i.e., calm temperament) often allows easier handling and may result in fewer adverse effects on animals. Calmer cattle have been shown to have greater growth rates and lower mortality rates in feedlot systems (Fell et al. 1999). In contrast, increased flight score and crush score have been associated with decreased growth rates, time spent feeding, and carcass weight (Cafe et al. 2011). Thus, management procedures which reduce reactivity in cattle may be beneficial for farmers and for the welfare of cattle. Therefore, the aim of this experiment was to determine whether yard weaning and/or frequent human contact would influence behavioural reactivity and liveweight gain of beef calves.

Materials and methods

This experiment was conducted at Massey University's Tuapaka farm with approval from the Massey University Animal Ethics Committee.

Animals

Sixty-four crossbred calves were used in the experiment. Calves were Charolais-sired heifers and steers born to seven-year-old Angus (n=25), Angus-cross-Friesian (n=15), Angus-cross-Jersey (n=17) and Angus-cross-Kiwicross (n=7) cows (Hickson et al. 2014). Calves were a mean of 198 days (SD 12 days) of age and 276.0 kg (SD 35.2 kg) at weaning (D0). Calves had been handled in the paddock twice within 48 hours of birth and through the yards four times prior to weaning.

Treatments

The experiment was a 2x2 factorial design, with the factors weaning location (paddock versus yards) and human contact (daily versus minimal). Each treatment combination had two replicates of eight calves to minimise the impact of any particularly unsettled calves on the behavioural responses of other calves in the treatment group. Dams were removed from sight and sound of the calves on D0.

Replicates were balanced for sex, breed, live weight, and initial temperament score. Yard-weaned calves were in two sets of adjacent pens allowing 18.0–30.9 m^2 area per calf. Fences provided a visual barrier between replicates to minimise interaction. Yard-weaned calves were offered pasture baleage *ad libitum* in one feeder per pen (fed on D0 and D4). The calves had not previously eaten baleage. The baleage had a mean metabolisable energy (ME) content of 9.8 MJ/kg DM, and crude protein (CP) content of 14.4%.

Paddock-weaned calves were grazed on ryegrass/white-clover pastures in four adjacent, flat paddocks that were 2.36–4.98 ha. Pre-grazing pasture mass ranged from 1958 kg DM/ha to 2426 kg DM/ha and was sufficient to allow *ad-libitum* intakes until D7 (Morris 2007). The pasture had a mean ME content of 10.3 MJ/kg DM, and CP content of 24.2%. A shelterbelt provided a visual barrier between the middle two paddocks, allowing a person in the second paddock to be unobserved by calves in the third paddock.

Yard-weaned calves in one set of adjacent pens and paddock-weaned calves in the first two paddocks received daily human contact. These calves were visited by the same handler for 18 minutes per day from D1 to D6. The handler maintained a consistent demeanour and spoke calmly. The handler moved as close to each calf as it would allow during each visit. On each day of contact, the handler changed his appearance, wearing overalls and gumboots on D1, a lab coat on D2, a hat on D3, carrying a stick on D4, wearing a neon high-visibility jacket on D5, and carrying a plastic bag on D6. Novel items were used to ensure that habituation was to general human contact as opposed to an individual.

On D2 two calves jumped out of the yarded, minimal-contact group and one escaped from the paddock minimal-contact group. These calves were returned to their respective mobs on D7 but were excluded from all measurements.

After measurements were made on D7, calves were separated into heifers and steers, and were grazed in those herds until D42. Calves were managed according to normal farm practice during this period, including a single yarding for oral drenching.

Measurements

Measurements of live weight, heart rate, temperament score and step count were made on D0, D7 and D42.

Heart rate was measured for 15 seconds via auscultation while restrained in a race. Calves then entered the weigh crate to measure behavioural reactivity (temperament score) and live weight. After temperament scores were measured, calves were moved through another race and exit time was measured.

Behavioural reactivity was assessed when calves were held individually for 30 seconds in a steel-floored 2.1 m^2 weigh crate with closed sides and open front. Temperament score was based on a five-point scale adapted from Grandin (1993): 1 = calm, no movement, head mostly still; 2 = slightly restless, looking around frequently, moving feet; 3 = frequently moving feet but not moving back and forth, excessive head movement; 4 = agitated, moving back and forth; 5 = agitated, continuous vigorous movement, snorting. Vocalisation and tail-twitching were interpreted as signs of agitation (Grandin 2015). The same assessor, blinded to treatment, made all assessments. Forelimb steps were counted for the 30-second period in the weigh crate.

Exit time was measured on D7 and D42. Calves were held individually in a 1.5 m^2 cattle crush for 20 seconds before being released through the front gate of the crush into a holding paddock. A thin blue string was placed on the ground in a 5 m radius from the crush gate and the time from release of the gate to a foot crossing the string was recorded.

Faecal samples were collected from fresh faeces on D0, D2, D7 and D42. Each sample comprised of 3 x 20 g subsamples, collected from a separate faecal mass. On D0, 10 samples were collected from the paddock where all 64 calves had been. On D2 and D7, two samples per replicate were collected. On D42, between 2 and 4 hours after calves were released from the yard, faecal samples were collected as deposited and identified to individual calves. Samples were frozen at -20°C for up to 50 days before being analysed by radio-immunoassay to determine corticosterone concentration using the method described by Little et al. (2015).

Statistical analysis

Data were analysed using SAS v9.4 (SAS Institute Inc., Cary, NC, USA). Live weight, liveweight gain, heart rate, change in heart rate, number of steps, and change in number of steps, were analysed using a general linear model that included the fixed effects of dam breed, sex of calf, weaning location, human contact and the interaction of weaning location with human contact. Exit time was normalised using a natural logarithm transformation before analysis using the same model. Temperament score and change in temperament score were analysed using a generalised model based on a Poisson distribution and a logit transformation. The model included the same fixed effects as the model for live weight. The mean and standard error of the mean was calculated for the initial faecal corticosterone concentration. Faecal corticosterone concentration at each time point in the experiment was analysed using a mixed model that included the fixed effects of weaning location and human contact.

Results

Paddock-weaned calves lost a greater amount of live weight between D0 and D7 than yard-weaned calves (Table 1). There was however, no difference in subsequent liveweight gain, and live weight did not differ among weaning treatments on D7 or D42. There were no interactions between weaning location and human contact for live weight or any other measure in this experiment.

On D7 the yard-weaned calves had a 21% lower (P=0.01) heart rate than the paddock-weaned calves (Table 2). From D0 to D7, paddock-weaned calves had an increase in heart rate whereas yard-weaned calves had a decrease in heart rate (P=0.02). There was no effect of human contact on heart rate at D7 or change in heart rate to D7 (Table

Table 1 Live weight and liveweight change of calves weaned either in the yard or paddock, and exposed to minimal or daily human contact in the seven days after weaning. Values are least squares mean ± S.E.M.

	Yard weaned	Paddock weaned	P-value	Daily contact	Minimal contact	P-value
Live weight (kg)						
D0	273.6 ± 5.6	279.6 ± 5.6	0.48	277.4 ± 5.6	275.2 ± 5.6	0.78
D7	268.3 ± 6	269.8 ± 5.9	0.85	271.5 ± 5.7	266.7 ± 6.1	0.55
D42	284.9 ± 5.9	288 ± 5.8	0.69	286.9 ± 5.6	285.9 ± 6.0	0.90
Liveweight change (kg/d)						
D0 to D7	-0.60 ± 0.17	-1.19 ± 0.16	0.01	-0.82 ± 0.16	-0.97 ± 0.17	0.52
D7 to D42	-0.47 ± 0.06	-0.52 ± 0.06	0.54	0.44 ± 0.05	0.55 ± 0.06	0.16
D0 to D42	-0.29 ± 0.05	-0.23 ± 0.05	0.35	0.23 ± 0.05	0.30 ± 0.05	0.32

Table 2 Heart rate and change in heart rate of calves weaned either in the yard or paddock, and exposed to minimal or daily human contact in the seven days post-weaning. Values are least squares mean ± S.E.M.

	Yard weaned	Paddock weaned	P-value	Daily contact	Minimal contact	P-value
Heart rate (beats/min)						
D0	91.6 ± 3.2	92.1 ± 3.2	0.91	93.2 ± 3.2	90.5 ± 3.2	0.54
D7	86.7 ± 4.7	105 ± 4.6	0.01	97.8 ± 4.5	93.9 ± 4.8	0.54
D42	102.3 ± 3.4	101.5 ± 3.4	0.85	97.3 ± 3.3	106.5 ± 3.5	0.05
Change in heart rate (beats/min)						
D0 to D7	-3.9 ± 5.2	13.1 ± 5.1	0.02	4.7 ± 5.0	-0.5 ± 5.3	0.98
D0 to D42	11.7 ± 4.2	9.6 ± 4.1	0.71	4.2 ± 4.0	17.1 ± 4.3	0.03

Table 3 Temperament score (1-5 scale where one is least reactive and five is most reactive), change in temperament score, number of steps, change in number of steps and exit time of calves weaned either in the yard or paddock, and exposed to minimal or daily human contact in the seven days post-weaning. Values are least squares mean ± S.E.M.

	Yard	Paddock	P-value	Daily contact	Minimal contact	P-value
Temperament Score (1-5 scale)						
D0	3.16 ± 0.34	3.21 ± 0.35	0.91	3.09 ± 0.33	3.28 ± 0.35	0.69
D7	2.16 ± 0.28	2.92 ± 0.33	0.07	2.28 ± 0.29	2.77 ± 0.32	0.23
D42	2.58 ± 0.30	2.78 ± 0.32	0.64	2.64 ± 0.31	2.72 ± 0.32	0.84
Change in temperament score						
D0 to D7	-1.01 ± 0.38	-0.29 ± 0.42	0.18	-0.77 ± 0.40	-0.56 ± 0.41	0.70
D0 to D42	-0.60 ± 0.41	-0.45 ± 0.41	0.79	-0.47 ± 0.41	-0.58 ± 0.41	0.84
Number of steps						
D0	19.8 ± 1.7	20.4 ± 1.7	0.80	20.5 ± 1.7	19.6 ± 1.7	0.68
D7	10.2 ± 1.7	12.4 ± 1.6	0.33	9.7 ± 1.6	13.0 ± 1.7	0.15
D42	16.3 ± 1.9	18.2 ± 1.9	0.46	18.0 ± 1.9	16.5 ± 2.0	0.54
Change in number of steps						
D0 to D7	9.9 ± 2.1	7.8 ± 2.1	0.45	10.8 ± 2	6.9 ± 2.1	0.16
D0 to D42	-3.9 ± 2.1	-1.9 ± 2.1	0.51	-2.4 ± 2	-3.4 ± 2.2	0.75
Exit Time (sec)						
D7	1.50 ± 0.09	1.34 ± 0.09	0.21	1.48 ± 0.09	1.35 ± 0.1	0.30
D42	1 .17 ± 0.05	1.07 ± 0.05	0.12	1.14 ± 0.05	1.10 ± 0.05	0.53

Table 4 Faecal corticosterone concentration (ng/ml) of calves weaned either in the yard or paddock, and exposed to minimal or daily human contact in the seven days post-weaning. Values are least squares mean ± S.E.M.

	Yard	Paddock	P-value	Daily contact	Minimal contact	P-value
D2	22.8 ± 2.11	23.5 ± 2.11	0.80	18.6 ± 2.11	27.6 ± 2.11	<0.01
D7	23.2 ± 1.93	24.0 ± 2.59	0.82	23.7 ± 2.44	23.5 ± 2.11	0.93
D42	22.6 ± 1.61	22.2 ± 1.30	0.83	22.2 ± 1.51	22.7 ± 1.42	0.82

2), but the heart rate of calves that had minimal human contact increased by more than that in calves that had been exposed to daily human contact. Furthermore, calves which had minimal human contact tended (P=0.05) to have a greater heart rate at D42 than calves that had human contact.

There was no difference in the temperament scores of yard-weaned and paddock-weaned calves on D0 or D42, however on D7 yard-weaned calves tended to have lower temperament scores than those of paddock-weaned calves (Table 3). There were no differences in change in temperament score, number of steps, change in number of steps or in exit time between yard-weaned and paddock-weaned calves. There was no effect of human contact on any of the behavioural variables measured, regardless of weaning location.

The mean pre-weaning faecal corticosterone concentration (baseline) was 21.8 ± 2.2 ng/g. There was no difference in corticosterone concentrations among the weaning locations (Table 4), but on D2, faecal corticosterone concentration was 48% greater in samples from calves with minimal human contact than in samples from calves with daily human contact. There were no differences from baseline for any group of calves except those weaned without human contact, which tended to be higher than baseline on D2 (P=0.08).

Discussion

Liveweight gain

Paddock-weaned calves lost significantly more weight than the yard-weaned calves in the seven days after weaning. Post-weaning liveweight loss in beef breed calves is expected in industry, and factors which contribute to this include changes in feed type, changes in social dynamics (separation from dam as well as establishment of hierarchy amongst calves), increased physical activity and decreased time spent grazing (Enriquez et al. 2011). The confined nature of the yard-weaning treatment may have limited the physical activity of the calves, relative to the paddock-weaned calves which spent considerable time pacing the fence line. In addition, the use of a bale feeder in the confined space meant there was readily available feed nearby to the yard-weaned calves at all times. Although the paddock-weaned calves had sufficient pasture available to achieve *ad-libitum* intakes, they would need to move away from the fence line they were pacing in order to reach it, and thus, may have been less inclined to consume feed.

Nevertheless, it is worth noting that this difference in liveweight gain immediately post-weaning was short term and was not sufficient to result in a difference in live weight of the calves at either D7 or D42. Therefore, this short-term advantage in liveweight gain due to yard weaning is of little practical benefit to the farmer.

Heart rate

Heart rate is increased during periods of acute stress or physical exertion in cattle (Ferguson et al. 2006), and therefore, an increased heart rate can be indicative of either a stress response or increased activity. The higher heart rate of paddock-weaned calves compared with yard-weaned calves on D7 may reflect a greater degree of stress induced by the measurement procedures, which included being yarded, handled and restrained. Alternatively, the difference in heart rate may have reflected that the paddock-weaned calves had run approximately 700 m to the yards in the 15-90 minutes prior to measurement while the yard-weaned groups had not.

Interestingly, on D42, calves that had received daily human contact after weaning had significantly lower heart rates than did calves which received minimal human contact during that time. Given that measurement of heart rate involved physical contact with a person, it is possible that these calves were more habituated to close human proximity. However, a similar effect was not observed on D7.

Behavioural reactivity

The yard-weaned calves tended to have lower temperament scores than the paddock-weaned calves on D7, suggesting that they were less behaviourally reactive to the testing procedures. This may be due to the yard-weaned calves being more familiar with the yard environment. In addition, yard-weaned calves may have been less agitated at the time of assessment compared to the paddock-weaned calves due to their run into the yards. The degree of human contact had no effect on any measure of behavioural reactivity, however, the practical limitations of managing calves in the post-weaning period, particularly the need to feed those in the yard, meant all groups had some human contact and thus, the results may have been different had there been greater difference in the degree of human contact between the treatments. The generally low temperament scores across all groups suggest that calves may have become habituated to the testing facility and weighing procedures during repeated exposures prior to weaning. This may have limited the potential for the experimental treatments to influence behavioural and physiological reactivity.

Faecal corticosterone

Faecal corticosterone concentrations were measured as an indicator of the stress experienced by calves subjected to different weaning methods. Calves that were weaned with minimal human contact had higher faecal corticosterone concentration on D2 than calves weaned with daily human contact. This suggests that calves weaned with frequent human contact experienced less stress in the 48 hours after separation from the dam than calves reared with minimal human contact, but further research is required to confirm this.

Conclusion

This experiment provides some evidence that yard weaning may have transient beneficial effects. Yard-weaned calves lost less weight, tended to be less behaviourally reactive and had lower heart rates during testing than did paddock-weaned calves after seven days of treatment. However, these benefits did not persist until 42 days post-weaning. Further investigation is necessary to determine whether these results are repeatable in calves with minimal exposure to humans and yards prior to weaning.

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