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Feed Choices: Cattle Preference for Feedlot or Pasture Environments

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Abstract

Intensive feedlot finishing is perceived by some people to affect welfare because cattle cannot perform normal behaviours evident in pasture environments, such as grazing. In order to develop objective scientific evidence concerning how cattle perceive the feedlot environment, cattle preference for spending time at pasture or in a feedlot was tested in two experiments. Cattle preference for a feedlot or pasture environment was not influenced by pasture availability, with cattle choosing to gain the majority of their energy requirements from the feedlot ration. Cattle spent 25-30% of their time in the feedlot. There was little feedlot activity at night between 2200 h and 0500 h. Feedlot feeding periods peaked at the start of the day around 0800 h with cattle preferring to be in the feedlot during the day. Cattle preferred to be in a pasture environment at night, where they spent around 50% of their time lying. When given free choice, it appeared that cattle took advantage of what they perceived to be the best elements of both environments. Not having this choice by confining cattle to either the feedlot or pasture environment alone does not necessarily indicate that their welfare would be compromised. These results indicate that not having access to pasture for grazing does not seem to be a major issue for cattle, as they prefer to meet their dietary requirements from the feedlot diet.

Executive Summary

There is a public perception that animal welfare is reduced under intensive animal farming systems compared with extensive or free-range systems. Many animal interest groups have strong positions against intensive systems where animals are confined, and use these as the focus of campaigns. Because feedlots are an intensive system, the feedlot industry is at risk of being presented and targeted as a system in which there is inherent animal suffering due to the nature of the production system itself. There is a lack of scientifically defensible evidence to either support or counter such claims.

The accredited feedlot industry in Australia can point to its QA management systems, animal health records and inspection processes to provide evidence on the health and management of its feedlot cattle. However, there is no current objective data to address any claims of animal suffering due to the confinement and intensity of the production system itself. Accordingly, it would be prescient for the feedlot industry to obtain objective, science-based evidence on how cattle perceive the feedlot environment, especially in comparison with being at pasture.

The purpose of this project was to provide this scientific data on how cattle perceive the feedlot compared with pasture. The study used the accepted practice of free choice preference testing to determine the preference of cattle for a feedlot or pasture environment, and further examined how the pasture availability influenced this preference. Intensive feedlot finishing is perceived to affect welfare because cattle cannot perform normal behaviours evident in pasture environments, such as grazing. The project objectives were to provide objective, science-based information on cattle perceptions of the well-managed feedlot environment through the conduct of free choice preference testing of a feedlot versus pasture environment under conditions of varying pasture availability.

In the first stage of the study (experiment 1), cattle preference for spending time at pasture (5 ha) or in a feedlot (25 x 10 m) environment was tested under two pasture availabilities, good (3900 kg DM/ha) and poor (1900 kg DM/ha). Five groups of Angus steers (n=6 animals per group; 454 ± 9.3 kg body weight) were tested in the good and poor pasture treatments (6 days per treatment). A commercial pelleted ration was available ad libitum in the feedlot. Electronic tag readers at the entrance and exit to the feedlot monitored animal movements between pasture and feedlot, and the cattle were fitted with IceTags™ to measure time spent lying and standing. Time spent eating in the feedlot was recorded with video cameras.

There was no significant effect of pasture treatment on total time spent in the feedlot (good 6.0 h, poor 6.1 h; P=0.9) nor on percent time spent standing (both 3.5 h; P=0.82) or lying (good 2.7, poor 2.5 h; P=0.31) within the feedlot. There was a tendency (P=0.06) for cattle to spend more time at the feeder when offered poor pasture (1.37 h) than good pasture (1.23 h) but group feed intake in the feedlot did not differ (P=0.19) between the good and poor pasture treatments (57.8 and 63.2 kg/day, respectively). Cattle spent more time standing in the paddock when offered good pasture (8.1 h) than when offered poor pasture (7.3 h; P=0.02), but lying in the paddock did not differ between good and poor pasture (10 and 10.6 h, respectively; P=0.31). On average, cattle spent 25% of their time in the feedlot and of that time, they spent 44% lying, 57% standing and 22% eating from the feeder. In the paddock, they spent 57% of their time lying and 42% standing. There was little feedlot activity at night between 2200 h and 0500 h. Feedlot feeding periods peaked at the start of the day (0600 to 0800 h) with two smaller peaks at 1200 h and 1800 to 2000 h.

For stage 2 of the project (Tullimba study), cattle preference was tested under commercial feedlot conditions. Three groups of steers (n=35 animals per group; 12-month-old; 75 Angus, 19

Angus x Hereford and 16 Angus x Santa Gertrudis; 248 ± 22.4 kg body weight) were tested simultaneously for 29 days. Each group had access to a feedlot pen (stocking density $9m^2$ per animal) or an attached paddock of 3.3 ha. Prior to free choice testing, all cattle were habituated to the experimental facilities by training them to enter and leave the feedlot and then spending 4 days confined only to the paddock and then 4 weeks in the feedlot only. Cattle movements in and out of the feedlot were monitored by video cameras and standing and lying behaviours were recorded using IceTags. Other measurements included feed intake, pasture availability and nutrient content, weather conditions and body weight.

In experiment 1, cattle preference for a feedlot or pasture environment was not influenced by pasture availability. In the Tullimba study, although the hypothesis of interest was that as pasture availability declines, cattle would spend more time in the feedlot, we were unable to clearly answer this question due to insufficient decline in pasture availability throughout the experiment. Two factors influenced this aspect of the study: the work was undertaken during an unusually good season with significant additional rainfall occurring during the study; and, despite the good quality of pasture on offer, the cattle consumed their daily energy requirements from the feedlot ration and therefore did not exert sufficient grazing pressure to reduce pasture availability.

In both studies, cattle consumed sufficient amounts of the feedlot ration to meet their daily energy requirements. Based on this intake, it appears that cattle prefer to eat the feedlot diet and were not dependent on pasture consumption and grazing to meet their energy requirements. We would expect that during the free choice phase cattle would continue to selectively graze their preferred pasture species but that the feed consumed would be acting more as an additional treat rather than as the main source of dietary intake. One of the main animal welfare concerns relating to feedlots is that cattle are unable to perform natural behaviours such as grazing. Our results indicate that the cattle prefer to gain their nutritional requirements from eating the feedlot diet than through grazing. However, this observation does not mean that grazing is not important to cattle or that their welfare is compromised if they are unable to graze. Further studies are needed to investigate the importance of pasture access and the opportunity to undertake grazing behaviour on the welfare of cattle.

The results of both experiments provide some insight into how cattle perceive the feedlot environment. In both experiments, cattle showed a similar pattern of entering the feedlot in the morning around 0800 and spending a significant amount of time during the day in the feedlot. The current industry practice of feeding cattle in feedlots twice a day, in the morning and afternoon therefore aligns well with the diurnal preferences of cattle shown in our studies. Cattle preferred the pasture environment at night, spending around 90% of their time at pasture, of which 50-80% was spent lying. An interesting finding of the studies is the similarity in the way cattle use their time for standing or lying over the 24 hour cycle regardless of their environment (i.e. feedlot or paddock). We can interpret this to indicate that for cattle choosing to be in the feedlot environment at any particular time, the environment did not disturb fulfilment of these behavioural needs.

The proactive position of the feedlot industry in investigating cattle perception of feedlots through objective research will help to address welfare concerns about feedlot practices. The findings from the two experiments indicate that not having access to pasture for grazing does not seem to be a major issue for cattle as they prefer to meet their dietary requirements from the feedlot diet. Although grazing is perceived by welfare advocates to have a strong positive effect on animal welfare, in reality, there are welfare benefits to both feedlot and pasture environments with no system alone being perfect. Rather, animals have some elasticity or latitude in their need to fulfil behavioural requirements that enables them to accommodate differences between the two environments before welfare impacts occur due to deficiency or excess.

When given free choice, cattle will take advantage of what they perceive to be the best elements of both environments. For example, cattle obtained the majority of their daily nutritional needs from the feedlot diet. Not having this choice by confining cattle to either the feedlot or pasture environment alone does not necessarily indicate that their welfare would be compromised. A popular criticism of feedlots is that cattle are not able to graze and also spend less time ruminating. Clearly, these results suggest that the reduction in grazing and rumination time was not a major issue.

The question that arises from this research is when cattle are not given access to the desired elements in each environment; does this automatically mean that their welfare has been adversely affected? To determine if access to the pasture or feedlot is a need or a luxury to cattle, then the experimental design should incorporate a cost to the decision that the animal makes. This could be achieved through making the animal work to gain access to the pasture such as through behavioural demand methodology or by confining the animal to the feedlot once it chooses to enter for a 24 h period. This would enable the strength of the animal's motivation to access the pasture to be determined which would be a stronger indicator of its welfare.

Contents

1 Background

There is a public perception that animal welfare is reduced under intensive animal farming systems compared with extensive or free range systems. Public criticism of husbandry environments such as cages for hens and stalls for sows is focused on the belief that the animals are unhappy in these confined and intensive environments. The looming attention on cattle feedlots is predicated on the same belief. The concern relates to the apparent "unnatural" housing conditions and the inability of the animal to express its full repertoire of natural behaviours. Although access to pasture is perceived to result in better welfare, there is no scientific evidence to either support or contradict this perception.

In order to develop objective scientific evidence concerning how cattle perceive the feedlot environment (as opposed to being at pasture), this study aims to objectively determine how cattle preference for a commercial feedlot or pasture environment changes as pasture feed availability declines. The hypothesis of interest is that as pasture availability declines, cattle spend more time in the feedlot.

2 Project Objectives

Provide objective, science-based information on cattle preferences of the well managed feedlot environment through the conduct of free choice preference testing of a feedlot versus pasture environment under conditions of varying pasture availability.

3 Methodology

The project comprised two separate experiments and the full report for experiment 1 is attached as Appendix 1. The methodology and results for experiment 2 (Tullimba study) are presented in this report.

3.1 Animals and facilities

The experiment was conducted at Tullimba, a feedlot at Armidale NSW, Australia. A total of 105 12-month-old steers (75 Angus, 19 Angus x Hereford and 16 Angus x Santa Gertrudis; 248 ± 22.4 kg body weight) were used for the study. The cattle were sourced from two properties. Animals arrived at the feedlot 6 weeks prior to the commencement of the study (24 and 27 August 2010). Upon arrival, animals were weighed and flight speed tested and kept at pasture. Cattle were randomly allocated to three groups that were balanced for weight, flight speed and property of origin (n=35 per replicate). The experimental facilities are shown in Figure 1. For the first 2 weeks of the free choice (the habituation phase), the average paddock size was 5.5 ha. However, as pasture availability was not declining sufficiently, the paddock size was reduced to 3.3 ha for the remaining 4 weeks. The feedlot and pasture environments contained identical water troughs and water from the same source. No shade was offered in either environment. The feedlot density of cattle was $9m^2$ per animal. Cattle were weighed (to the nearest kg) at the beginning and end of the feed choice testing.

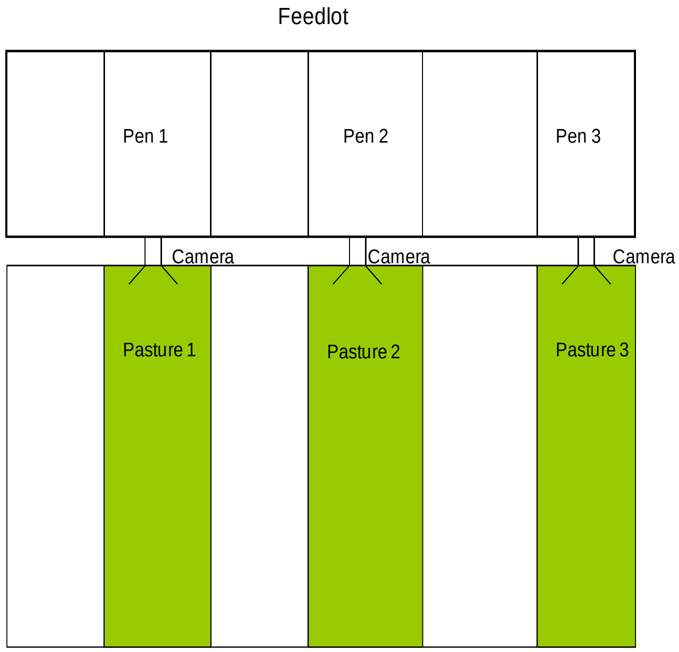

Figure 1. The experimental set up with three feedlot pens each with access to an adjoining paddock to allow free choice assessment of cattle preference.

3.2 Habituation

All cattle were habituated to the experimental facilities. This involved training cattle to use the gates to enter and leave the feedlot on four occasions over a 2-week period. On each training day, a temporary electric fence was set up to contain cattle close to the feedlot, then each animal was encouraged to enter and leave the feedlot through the race a total of three times in each direction. Next, cattle were restricted to the specific paddock to be used for 4 days, and then restricted to the specific feedlot pen to be used for 4 weeks. Cattle then had 2 weeks of free choice where they could choose between the feedlot and paddock followed by one additional training session to reinforce learning of entering and leaving the feedlot.

3.3 Testing free choice

The cattle were given 29 days of free choice testing. The 3 pen groups were tested simultaneously. Prior to testing, all cattle were marked by first shaving the area and then painting a number with peroxide dye along the midline to enable identification. On the day before testing, 10 animals per group were fitted with IceTags (IceRobotics, Midlothian, Scotland) to record time spent lying and standing (Figure 2). The gates between the feedlot and pasture were monitored with 2 video cameras (SCC_B2013P Colour Camera, Samsung, Homebush, Australia) for the duration of the testing to record animals entering and leaving the feedlot (Figure 3). A sensor was used to detect low light levels which activated spot lights at night to allow recording of cattle movements.

Figure 2. An animal fitted with an IceTag on the hind leg.

Figure 3. Entry and exit to the feedlot was monitored by video cameras.

3.4 Feedlot ration and intake

The cattle were gradually introduced to the feedlot diet by reducing the roughage content over the 4-week feedlot habituation stage to prevent acidosis. The ration provided in the feedlot was gradually reduced from 60% to 25% roughage during habituation and remained at this level during the free choice phase of the experiment. Other components of the diet were grain, molafos, lime and bicarbonate. Feed was offered ad libitum and was replaced daily at 0830. Feed residue was measured to enable calculation of daily feed intake per group. A feed sample was collected weekly from each group for analysis of nutritive value. The analysis of the feedlot rations are shown in Table 1.

Table 1. Nutritive value analysis of the feedlot rations.

Ration (%)	NDF	ADF	CP	ASH	OM	DMD	DOMD	ME (MJ/kg DM)	Crude fat
Starter	32	19	17.9	9	91	69	68	10.7	1.5
Free choice	28	15	17.1	8	92	73	73	11.4	2

Figure 4. Cattle eating in the feedlot.

Figure 5. Groups of cattle in the feedlot and at pasture

3.5 Pasture and weather conditions

Pasture availability and nutritive value were monitored by pasture sampling at weekly intervals. This involved collecting 10 samples from each paddock using a quadrant. Samples were oven dried for 4 days for calculation of dry weight. Following this, samples were pooled for analysis of nutritive value to provide a representation of the each pasture for each of the 4 weeks of the experiment. Nutritive value measures included neutral detergent fibre (NDF; hemicellulose, cellulose and lignin), acid detergent fibre (ADF; cellulose and lignin), crude protein (CP), ash (total inorganic matter), organic matter (OM), dry matter digestibility (DMD), dry organic matter digestibility (DOMD) and metabolisable energy (ME). The climatic conditions prevailing during the experiment were measured using a portable weather station (Figure 6; Monitor Sensors, Australia). The measures recorded daily were minimum and maximum temperature, rainfall, wind speed and humidity.

Figure 6. Portable weather station used to monitor climatic conditions during the experiment.

3.6 Data analysis

The behavioural variables analysed were the percent of time spent in the paddock and feedlot, the percent of time spent standing or lying in the paddock and feedlot and the number of steps taken. Group feed intake in the feedlot was also measured. Pasture measures included nutritive value and herbage mass on offer. All measures were tested for normality and transformations were made where necessary. Data were analysed using ASREML (Gilmour et al., 2006), with a linear model including day as a fixed effect, group as a random effect and group by day interactions. Pasture herbage mass was tested as a covariate in the analysis and was found to be non-significant so was not included in the final model.

4 Results and Discussion

4.1 Results

4.1.1 Behaviour in feedlot and at pasture

There were significant group x day effects on time spent in the feedlot and at pasture ($P<0.001$; Figure 7). When herbage mass was fitted as a covariate there was no effect of time spent in the feedlot and at pasture. There were significant group x day interactions for time spent standing and lying and the number of steps in the feedlot and at pasture ($P<0.001$; Figure 8, 9, 10 and 11). When tested within days there were significant differences between groups, however there were no meaningful trends to be observed in these differences, therefore the pattern of these differences can be best shown visually in the Figures. The average number of animals entering the feedlot over a 24 h period is shown in Figure 12. From around 0800, most of the cattle entered the feedlot which coincided with placement of new feed and they remained in the feedlot until dusk. The time profiles for behaviours when in the feedlot and in the paddock are shown in Figure 13. Cattle preferred to be in the feedlot during the day and in the paddock at night. Despite their choice of environment, the diurnal patterns of standing and lying behaviours are similar in both the feedlot and pasture environment.

Table 2 shows the averages for behaviours during the 2-week habituation phase and 4-week free choice testing phase. During the habituation phase, most cattle remained at pasture (23.6 h/day), whereas during the free choice testing phase cattle spent 5.8 h/day in the feedlot. Cattle showed similar activity profiles for total lying and standing but took more steps when mostly at pasture during habituation.

Table 2. Average activity and time spent in the feedlot and paddock during the 2-week free choice habituation phase and the free choice testing phase.

	Habituation	Free choice testing
Feedlot (h)	0.4	7.4
Pasture (h)	23.6	16.6
Feedlot standing (h)	0.3	5.8
Feedlot lying (h)	0.08	1.70
Pasture standing (h)	12.7	6.8
Pasture lying (h)	10.9	9.7
No. Steps at pasture	1336	976
No. Steps feedlot	23	452
Total standing (h)	13.0	12.6

Total lying (h)	11.0	11.4

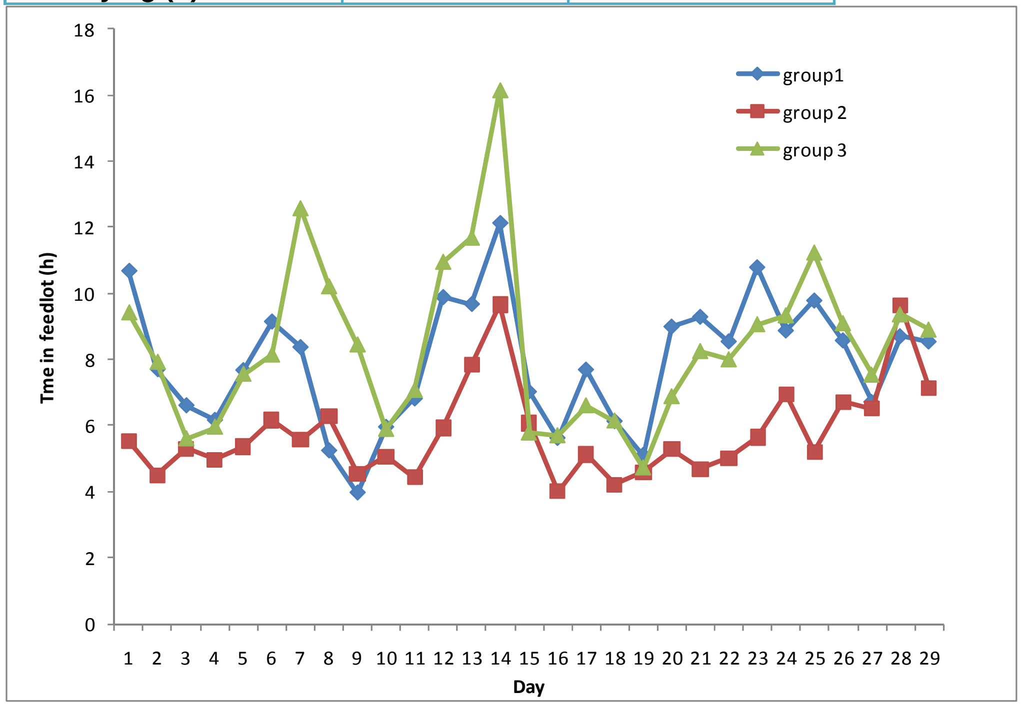

Figure 7. Average time spent in the feedlot per day for the three groups.

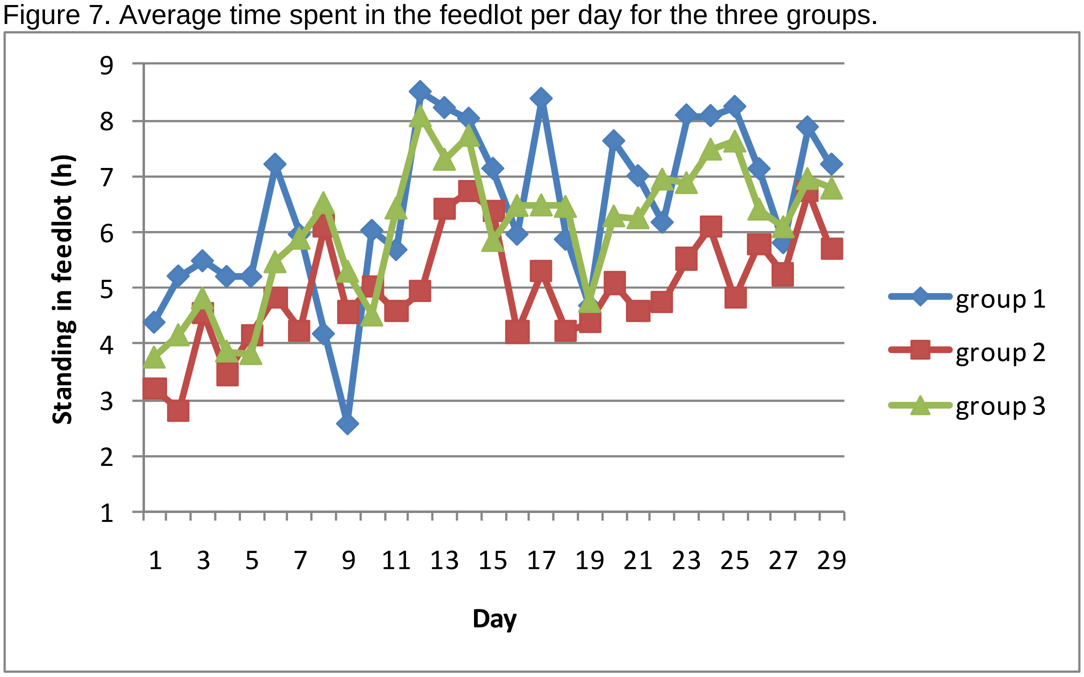

Figure 8. Average time spent standing in the feedlot per day for the three groups.

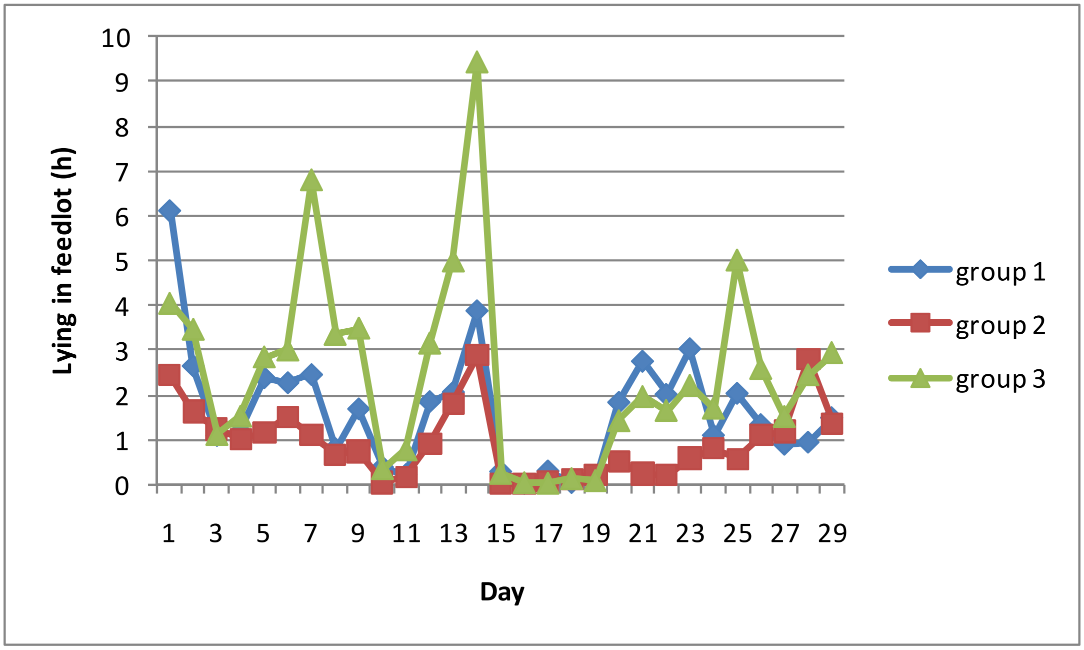

Figure 9. Average time spent lying in the feedlot per day for the three groups.

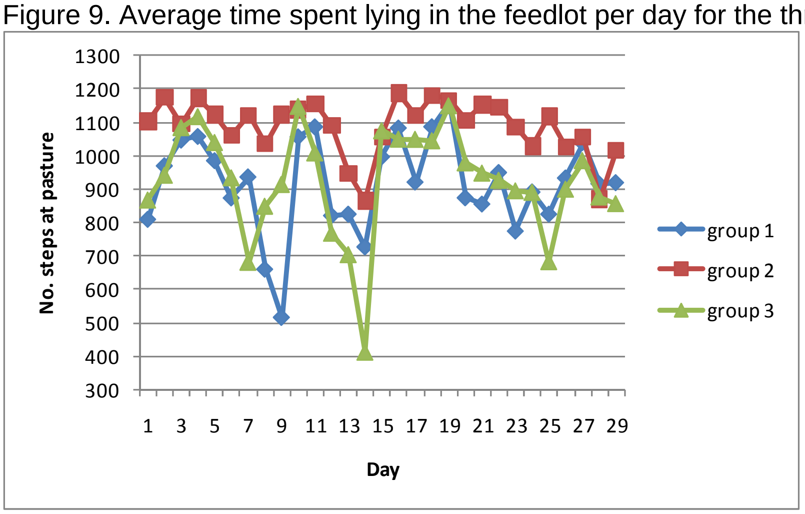

Figure 10. Average number of steps taken per day when animals were at pasture.

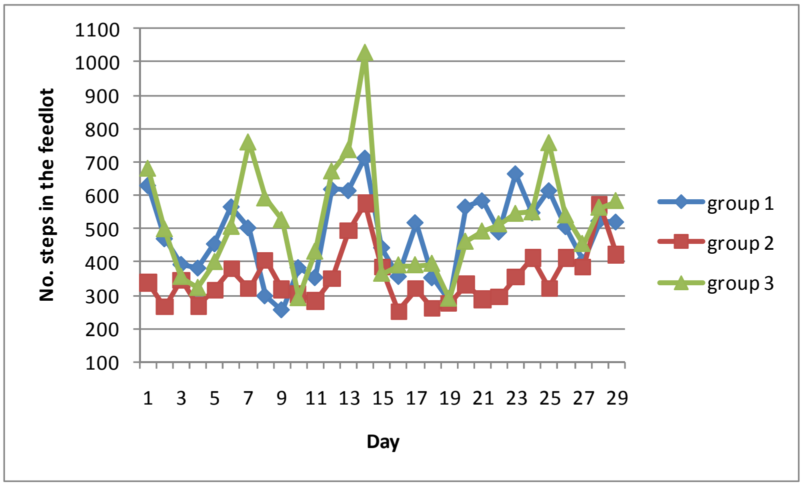

Figure 11. Average number of steps taken per day when animals were in the feedlot.

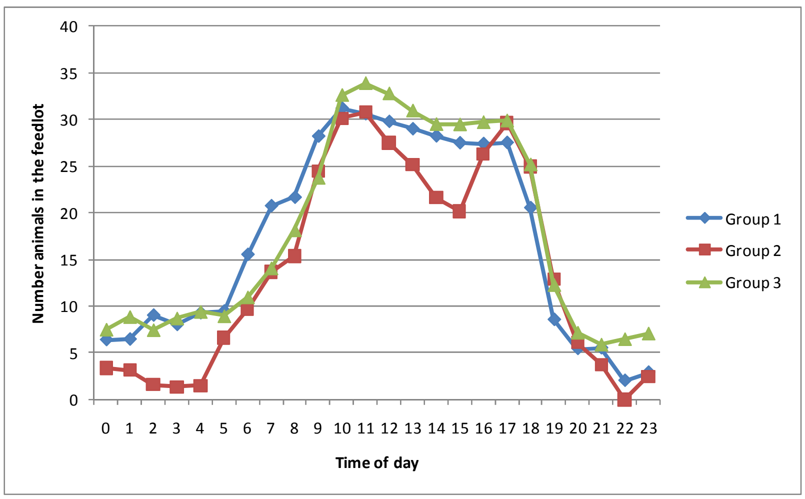

Figure 12. Number of cattle per group of 35 animals that were in the feedlot at hourly intervals over a 24 h period.

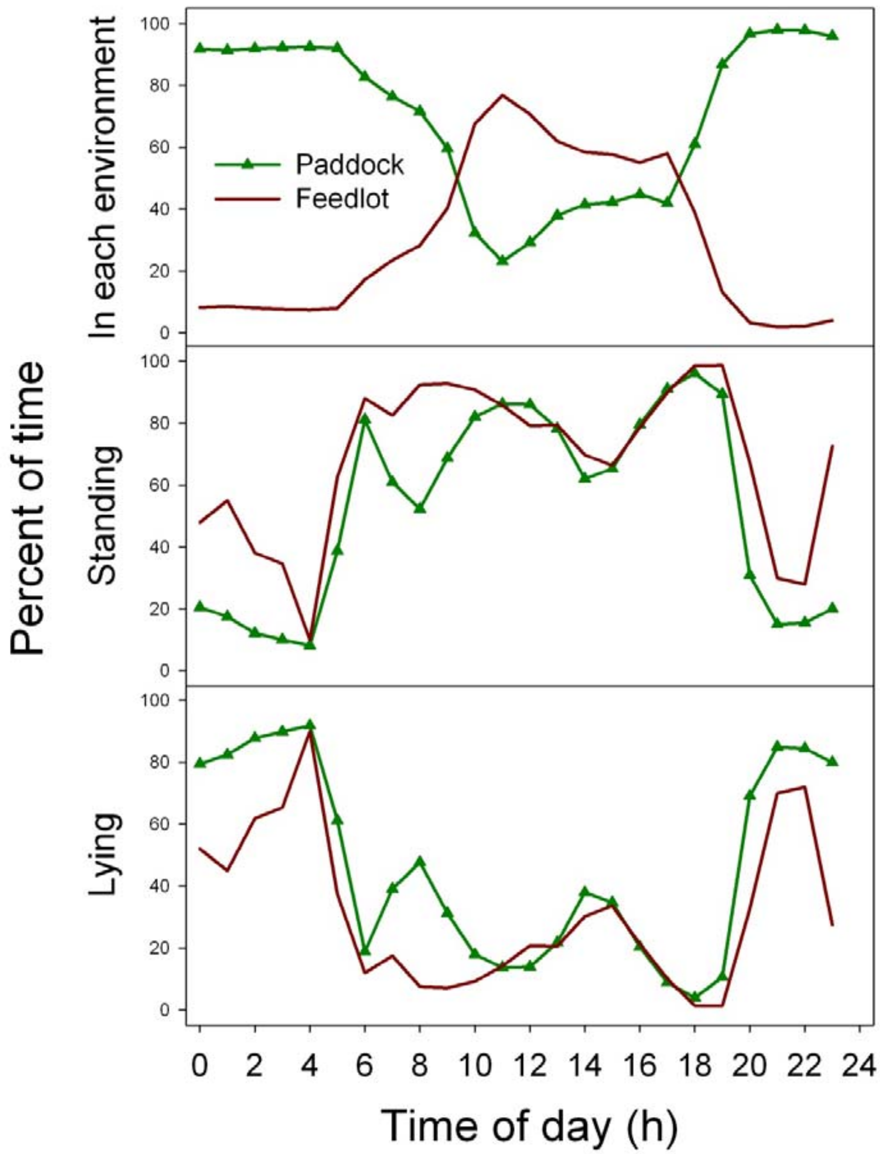

Figure 13. Average feedlot and pasture behaviour profile for 24 hours.

4.1.2 Feed intake and visits to feedlot

There was a significant difference (P<0.001) between days and groups for feed intake in the feedlot and number of visits to the feedlot per day (Figures 14 and 15). On average per day, cattle consumed 10.3 kg of feed in the feedlot and gained 1.26 kg in body weight during the free choice testing period. Cattle appeared to increase their feed intake over time in the feedlot.

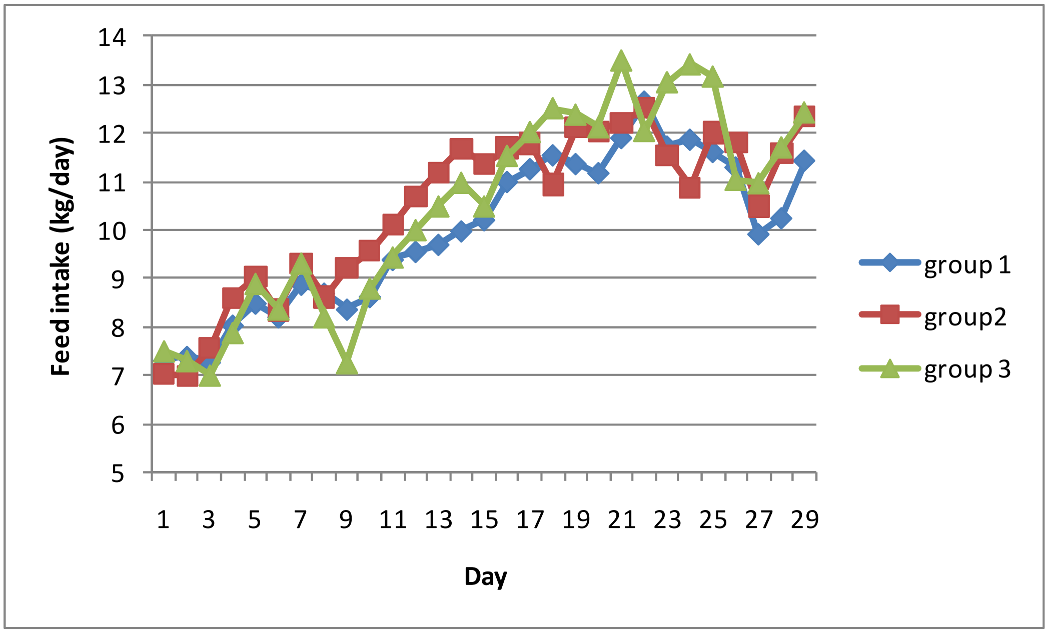

Figure 14. Average feed intake in the feedlot per animal per day.

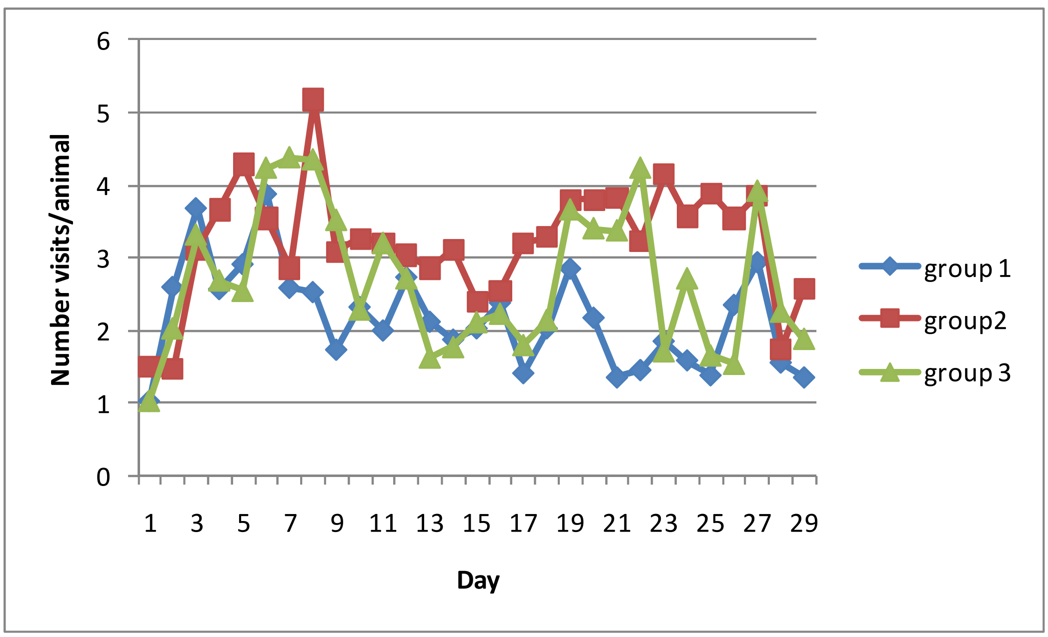

Figure 15. Number of visits to the feedlot per animal per day.

4.1.3 Pasture

The herbage mass did not differ significantly between weeks but did differ between groups (Figure 16). The nutritive value of the pasture did not differ between groups or days throughout the experimental period (Table 3). Herbage mass on offer was not a significant covariate for any behavioural variable.

Table 3. Pasture nutritive analysis

Pasture measure	Group 1	Group 2	Group 3
Neutral detergent fibre (%)	63.2	61	64.6
Acid detergent fibre (%)	36.4	36.4	36.6
Crude protein (%)	10.56	9.74	9.00
ASH (%)	5.8	6.4	5.0
Organic matter (%)	94.2	93.6	95.0
Dry matter digestibility (%)	54.2	53.6	54.0
Dry organic matter digestibility (%)	52.8	52.0	52.6
Metabolisable energy (MJ/kg DM)	7.70	7.54	7.68
Herbage mass (kg DM/ha)	4257	3065	3642

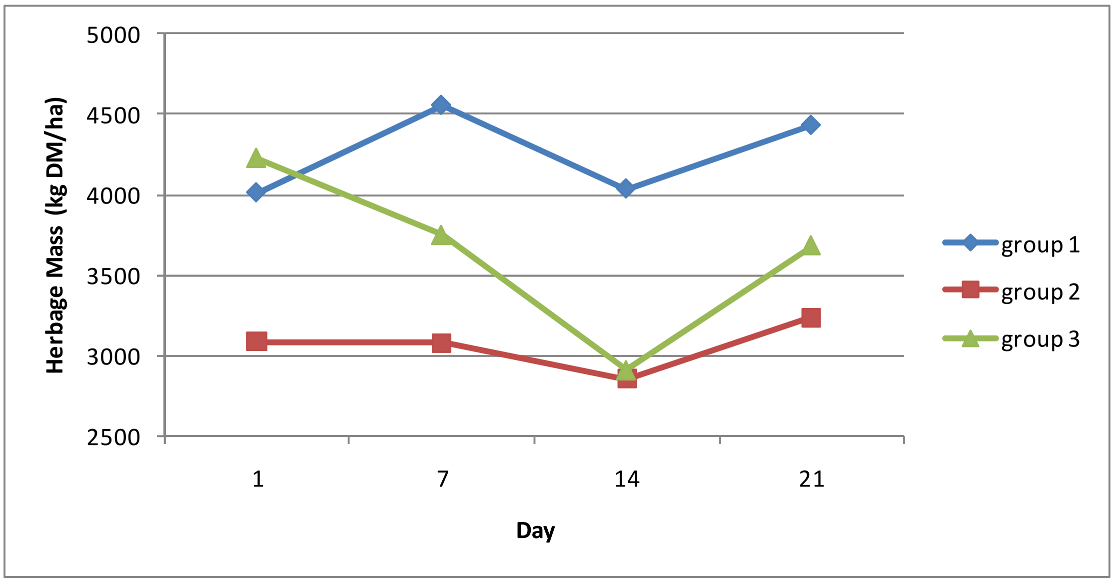

Figure 16. Herbage mass sampled weekly in the paddocks.

4.1.4 Weather conditions

Daily temperature and rainfall profiles are shown in Figures 17 and 18. During the free choice test period, the average minimum temperature was 11.2°C and maximum was 23.2°C. Average rainfall was 4.0 mm/day.

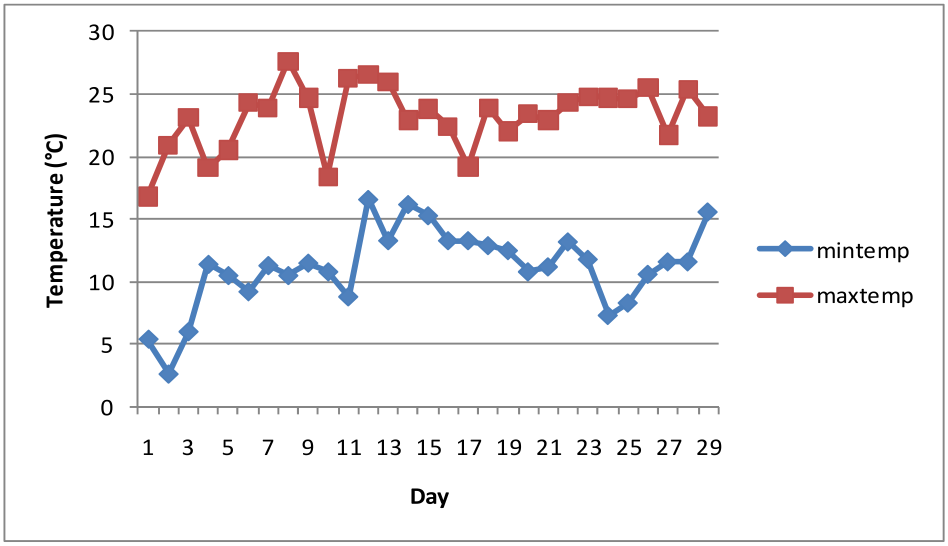

Figure 17. Average daily maximum and minimum temperatures during the free choice testing.

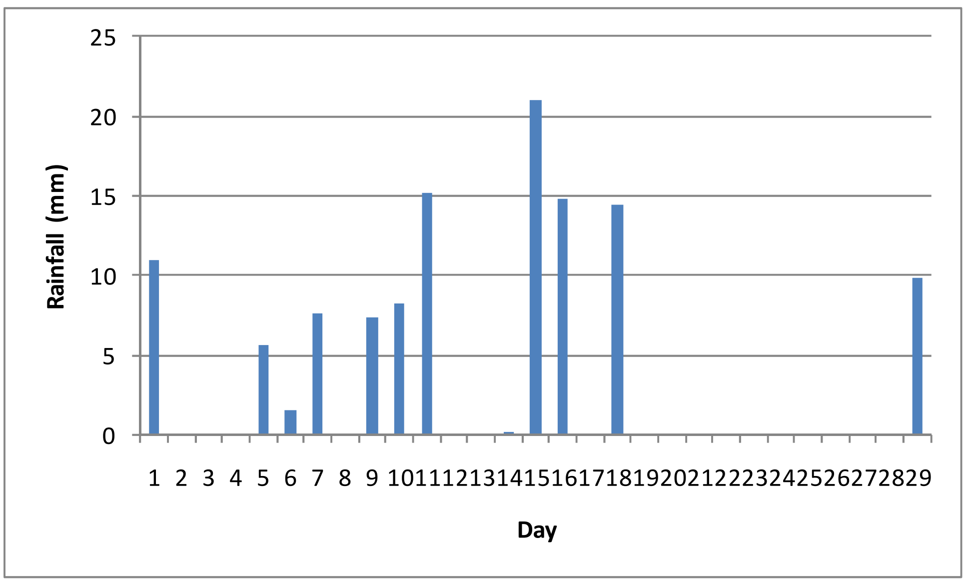

Figure 18. Daily rainfall during the free choice testing.

4.2 Discussion

This study provides new insight into how cattle spend their time when given a choice between commercial feedlot and pasture environments. When given free choice, cattle spend on average 7.4 h in the feedlot and 16.6 h at pasture. Of their time in the feedlot, they spend 5.8 h standing and 1.7 h lying, and at pasture they spend 6.8 h standing and 9.7 h lying. The design of both the previous study (experiment 1, see Appendix 1 milestone report) and the Tullimba experiment was such that animals could choose where to spend their time and therefore, were able to select their preferred environment at particular times of the day.

From the diurnal profiles, it is evident that cattle prefer to be in the feedlot during the day and at pasture at night. From both studies, cattle prefer to lie in the pasture environment. This result is supported by the findings of Ketelaar-de Lauwere et al. (1999) who reported that when dairy cows had the choice between indoors and outdoors, they spent most of their lying time at pasture. Krohn et al. (1992) also found that cows prefer to lie in the pasture rather than in cubicles. However, there are conflicting reports that cattle prefer to be indoors and lying at night (Charlton et al., 2011). These differences may be related to climatic conditions as cattle are reported to prefer pasture in summer months (Ketelaar-de Lauwere et al., 2000), and rain and temperature were found to be positively correlated with sheltering in cattle (Vandenheede et al., 1995).

As this study enabled cattle to select what they perceived to be the best aspects from both environments, not having this choice by confining cattle to either the feedlot or pasture environment alone does not necessarily indicate that their welfare would be compromised. To determine if access to the pasture or feedlot is a need or a luxury to cattle, then the experimental design would need to incorporate a cost to the decision that the animal makes. This could be achieved through making the animal work to gain access to the pasture, such as through behavioural demand methodology or by confining the animal to the feedlot once it chooses to enter for a 24-h period. This would enable the strength of the animal's motivation to access the pasture to be determined, which would be a stronger indicator of its welfare (Matthews, 2008).

In this study, we found that on average cattle chose to consume 10.3 kg of the feedlot diet per animal, which would meet their daily energy requirements and would be fairly typical for cattle confined to a feedlot. Based on this intake, it appears that cattle prefer to eat the feedlot diet and were not dependent on pasture consumption and grazing to meet their energy requirements. A similar result was found in experiment 1, where cattle also consumed most of their daily nutritional needs with the feedlot diet alone. The feeding of supplements has been reported to reduce grazing time by 22 min per kg of concentrates given (Sarker and Holmes, 1974), and thus substitutes for herbage intake (Phillips and Leaver, 1986). Therefore, in the present research, intake of the feedlot ration would have made cattle less reliant on the pasture as a feed source. Since grazing behaviour and pasture consumption were not measured, it is not known how much pasture the cattle actually consumed. The pasture availability of 3042 kg DM/ha, crude protein of 9.8% and metabolisable energy of 7.6 MJ/kg DM would have supported maximum feed intakes in cattle (Bell, 2006). Other studies have measured time spent grazing at pasture when cattle were given a choice between indoor housing and pasture, with Charlton et al. (2011) reporting cattle spent 48% of 1.6 h at pasture grazing whereas Krohn et al (1992) reported cattle grazed for 4 h per day.

The 2-week habituation free choice phase where cattle remained largely at pasture provided a comparison with the free choice phase and showed that cattle took more steps (1336 vs. 976), which was most likely due to additional grazing activity undertaken when cattle where fulfilling their dietary requirements from pasture rather than from the feedlot ration. We would expect that during the free choice phase cattle continued to selectively graze their preferred pasture species, but that the feed consumed would be acting more as an additional treat. One of the main animal welfare concerns relating to feedlots is that cattle are unable to perform natural behaviours such as grazing. Our results indicate that the cattle prefer to gain their nutritional requirements from eating the feedlot diet more than through grazing. However, this observation does not mean that grazing is not important to cattle or that their welfare is not compromised if they are unable to graze. Despite some viewpoints that cattle welfare is increased with increased grazing time (Bartussek et al., 2000), there is no scientific proof of such a relationship. Further studies are needed to investigate the importance of pasture access and the opportunity to undertake grazing behaviour on the welfare of cattle.

Although the hypothesis of interest was that as pasture availability declined, cattle would spend more time in the feedlot, we were unable to clearly answer this question in the Tullimba study due to an insufficient decline in pasture availability throughout the experiment. Two factors influenced this aspect of the study: the work was undertaken during an unusually good season with significant additional rainfall occurring during the study; and, despite the good quality of pasture on offer, the cattle consumed their daily energy requirements from the feedlot ration and therefore did not exert sufficient grazing pressure to reduce pasture availability. However, in the previous experiment, where cattle were exposed to different pasture availabilities, there were no differences in the time spent in the feedlot. There were some small differences in pasture quality between the Tullimba study and experiment 1 with higher crude protein (9.8% vs. 6.3%) and metabolisable energy (7.6 vs 5.8 MJ/kg DM), however we would not expect this to have much influence on the choice cattle make.

The results of both experiment 1 and the Tullimba study provide some insight into how cattle perceive the feedlot environment. In both experiments, cattle showed a similar pattern of entering the feedlot in the morning around 0800 and spending a significant amount of time during the day in the feedlot. These similar activity patterns indicate that the time-based cue of feed being deposited daily in the feed bunker did not influence the choice of entering the feedlot as it still occurred when this cue was not present (experiment 1).The current industry practice of providing fresh feed to cattle in feedlots twice a day, in the morning and afternoon therefore aligns well with the diurnal preferences of cattle shown in our studies. A similar pattern of eating was reported in feedlot cattle in summer in the US, with a peak at 0600 to 0900 am and very little eating at night (Hoffman and Self, 1973). In both experiment 1 and the Tullimba study, cattle preferred the pasture environment at night, spending around 90% of their time at pasture, of which 50-80% was spent lying. Legrand et al., 2009 reported similar findings with cattle preferring pasture at night and an indoor environment during the day. In experiment 1, cattle spent 25% of their time in the feedlot, and in the Tullimba study this was increased to around 30%. In experiment 1, cattle lay for 2.6 h on average in the feedlot per day, whereas in the commercial environment at Tullimba they lay for 1.7 h. This may be due to differences in the group size (5 vs. 35 animals per group) as this can influence behaviour patterns (Jorgensen et al., 2009). Cattle have been shown to synchronise their activities (Rook and Penning, 1991) and this was evident in both of our studies with cattle entering and leaving the feedlot, lying and standing at similar times. An interesting finding of the current study is the similarity in the way cattle use their time for standing or lying over the 24 hour cycle regardless of their environment (ie. feedlot or paddock). We can interpret this to indicate that for cattle choosing to be in the feedlot environment at any particular time, the environment did not disturb fulfilment of these behavioural needs. Cattle typically lie for 11-13 h per day and restriction of lying can lead to elevated cortisol, an indicator of stress (Fisher et al., 2002).

The proactive position of the feedlot industry in investigating cattle perception of feedlots through objective research will help to address welfare concerns about feedlot practices. The findings from the two experiments indicate that not having access to pasture for grazing does not seem to be a major issue for cattle as they prefer to meet their dietary requirements from the feedlot diet. There is a growing body of research into comparing housing systems, particularly in the intensive pig and poultry industries. The findings from this research are that there are positives and negatives associated with each housing system (e.g. Sherwin et al., 2010). Grazing in pasture environments is thought to have a strong positive effect on animal welfare (Kondo, 2011). However, a pasture system is not a static environment and animals can be exposed to reduced pasture quality and/or availability due to conditions such as drought. In reality, there are welfare benefits to both feedlot and pasture environments with no system alone being perfect. Rather, animals have some elasticity or latitude in their need to fulfil behavioural requirements that enables them to accommodate differences between environments before welfare impacts occur due to deficiency or excess.

5 Success in Achieving Objectives

The objectives as outlined in section 2 have been achieved through the successful completion of the 2 experiments. These are the first experiments of their type to provide insight into how cattle perceive the feedlot and pasture environments. A clear outcome of both the Tullimba study and experiment 1 was that cattle preferred to obtain their dietary requirements from the feedlot diet with grazing acting as a supplementary activity

A journal manuscript from Experiment 1 has been prepared for submission to Applied Animal Behaviour Science and an abstract from this work has been submitted to the International Society of Applied Ethology meeting to be held on 31st July 2011 in Indianapolis, USA. A journal paper from the Tullimba study will be submitted to a peer review journal.

Lee, C., Fisher, Colditz, Lea, Ferguson. 2011. The effect of pasture availability on cattle preference for pasture or feedlot environments. Applied Animal Behaviour Science.

6 Impact on Meat and Livestock Industry – now & in five years time

The goal of the project was to provide objective scientific evidence concerning how cattle perceive the feedlot environment. The results of the project provide information on what cattle prefer, and can be utilised by industry in defence of feedlot production systems and practices. In addition, in 5 years time, the journal papers once published will serve as a peer reviewed source of information.

7 Conclusions and Recommendations

When given free choice, cattle will take advantage of what they perceive to be the best elements of both environments. For example, cattle obtained the majority of their daily nutritional needs from the feedlot diet. A popular criticism of feedlots is that cattle are not able to graze and also spend less time ruminating. Clearly, these results suggest that the reduction in grazing and rumination time was not a major issue.

The question that arises from this research is when cattle are not given access to the desired elements in each environment; does this automatically mean that their welfare has been adversely affected? Preference testing enables assessment of animal choice (Dawkins, 1990). However, the preference testing methodology does not inform us of how important the choice is to the animal. In contrast, behavioural demand methodology enables us to determine the strength of an animal's motivation to gain a resource (Kirkden and Pajor, 2006). Future studies using demand methodology such as 1) making animals work to gain access to pasture by say, pressing a lever, or 2) inclusion of a cost to the animal's choice such as locking the animal in the feedlot for 24 h once it enters, will enable assessment of the strength of the preference for the feedlot v pasture environment.

Furthermore, the current study did not include any additional resources in the pasture or feedlot such as shade or improved pasture quality which may influence preference. Future studies could investigate the influence of additional environmental factors and enrichments on cattle preferences.

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9 Appendices

Milestone report

MLA project code:	BFLT.0349
MLA project title:	Feed choices: Cattle preference for feedlot or pasture environments
Project leader:	Caroline Lee
MLA project manager/coordinator:	Des Rinehart
Milestone number:	4

Milestone
Milestone report detailing results of stage 1 submitted to MLA and reviewed by the advisory committee.

Abstract
Stage 1 experimental work to assess the preference of cattle for pasture or feedlot environments has been completed. Five groups (n=6 animals per group; total 30 animals) were tested under poor and good pasture conditions. Pasture availability (herbage mass) was significantly higher in the good pasture than the poor pasture treatment, however the nutritive value did not differ. There was no difference between times spent in the feedlot under the different pasture conditions. Nor were there any significant differences in time spent in the paddock or feedlot lying, standing or eating when cattle were in paddocks offering good and poor pasture availability. On average cattle spent 25% of their time in the feedlot when given a choice of either good or poor pasture. In the feedlot, they spent 44% lying, 57% standing and 22% eating from the feeder. In the paddock, they spent 57% of their time lying and 42% standing. Feedlot feeding periods peaked at the start of the day (6 to 8 am) with 2 smaller peaks at midday and 6 to 8 pm. There was little feeding activity at night between 10 pm and 5 am. In conclusion, cattle preference for a feedlot or pasture was not influenced by pasture availability.

Project objectives

Provide objective, science-based information on cattle preferences of the well managed feedlot environment through the conduct of free choice preference testing of a feedlot versus pasture environment under conditions of varying pasture availability.

Success in achieving milestone

The effect of pasture availability on cattle preference for feedlot or pasture environments

Caroline Lee, Andrew Fisher, Ian Colditz, Jim Lea, Tim Dyall, Sue Belson and Drewe Ferguson

Introduction

There is a public perception that animal welfare is reduced under intensive animal farming systems compared with extensive or free range systems. Public criticism of husbandry environments such as cages for hens and stalls for sows is focused on the belief that the animals are unhappy in these confined and intensive environments. The looming attention on cattle feedlots is predicated on the same belief. The concern relates to the apparent "unnatural" housing conditions and the inability of the animal to express its full repertoire of natural behaviours. Although access to pasture is perceived to result in better welfare, there is no scientific evidence to either confirm or deny this.

In order to develop objective scientific evidence concerning how cattle perceive the feedlot environment (as opposed to being at pasture), this study aims to objectively assess how cattle spend their time when given a free choice between a feedlot environment and pasture of differing availability. The hypothesis of interest is that as pasture availability declines, cattle spend more time in the feedlot.

Materials and Methods

Ethical approval of animal experimentation

The protocol and conduct of the study were approved by the McMaster Laboratory Animal Ethics Committee, under the New South Wales Animal Research Act 1985.

Animals and facilities

The experiment was conducted at Armidale NSW, Australia. A total of 30 12-month-old Angus steers (453.8 ± 9.33kg body weight) were used for the study. The experimental facilities are shown in Figure 1 and Figure 2. An approximately 30 ha area of pasture was divided into good and poor pasture. The good and poor pasture areas were further divided into 3 paddocks each of approximately 5 ha in size. The poor pasture was created by pre-grazing and slashing the paddock to reduce feed availability and the good paddock was not slashed or grazed prior to the study (Figure 3). Because it was intended to see how animals respond to conditions that in real life would be ongoing, it was not intended that the poor pasture be so poor as to represent a significant weight loss to the animals. The feedlot was 25 x 10 m in size which was sufficient to contain the animals at the recommended feedlot density of at least 9 m2 per animal. The feed was placed in a weatherproof commercial cattle feeder which was set on weigh scales to record group feed intake. The feedlot pad was well drained and sloped. The feedlot and pasture environments contained identical water troughs and water from the same source. No shade was offered in either environment (apart from that provided by the feeder unit and equivalent shade provided in the paddocks to balance the environments, see Figure 3). Tag readers (Aleis International Pty Ltd, Jandowae, QLD, Australia) were placed at the entrance and exit to the feedlot to monitor animal movements and one-way spear gates prevented animals from backing out of the gate once entered (see Figure 4).

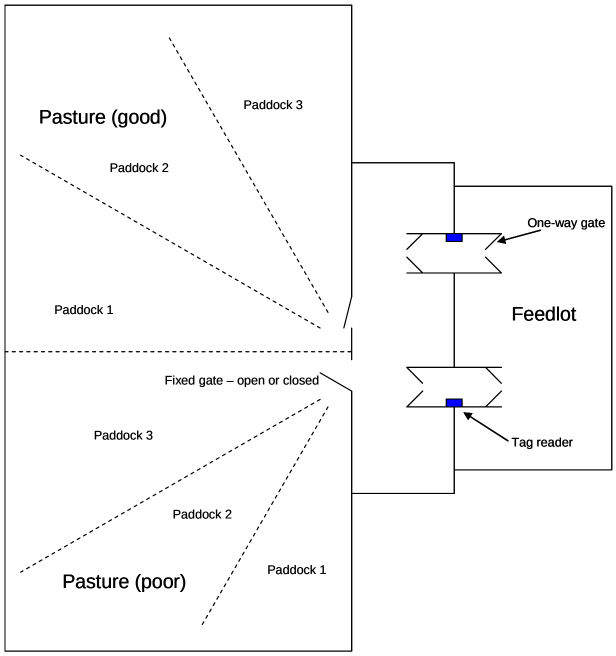

Figure 1. Feed choices paddock and feedlot design.

Figure 2. Cattle in the feedlot facility.


Figure 3. The poor (left) and good (right) pasture environments. A dummy feeder unit was placed in each paddock to replicate the shade created by the feeder unit in the feedlot.


Figure 4. Tag reader and one-way spear gate to enter the feedlot.

Feedlot ration, pasture and rainfall
The feed provided in the feedlot was a starter feedlot ration (Supreme stock feeds, Guyra, NSW, Australia; see Appendix 1 for feed analysis) that was not too heavy in concentrates in order to avoid ruminal acidosis as the cattle moved from pasture to feedlot. Feed was offered ad libitum and group feed intake was measured daily. Pasture samples were collected from each paddock using a quadrat at the start and end of testing each group (Figure 5). This involved collecting 10 samples from both the good and poor paddocks. Samples were oven dried for 4 d for calculation of dry weight. Following this, samples were pooled for analysis of nutritive value to provide a representation of the good and all poor pastures for each group. Nutritive value measures were neutral detergent fibre (NDF; hemicellulose, cellulose and lignin), acid detergent fibre (ADF; cellulose and lignin), crude protein (CP), ash (total inorganic matter), organic matter (OM), dry

matter digestibility (DMD), dry organic matter digestibility (DOMD) and metabolisable energy (ME). Rainfall data was collected from daily meteorological records.

Figure 5. Pasture sampling using the quadrat.

Habituation

All animals were habituated to the experimental facilities and feedlot ration. This involved introducing the feedlot ration to all animals in their home paddock over a period of 2 weeks. Next, animals were moved to the feedlot facility where they were encouraged to move through the gates to learn how to enter and leave the feedlot. Most cattle were moving calmly in and out of the feedlot by the fifth entry. The habituation and testing schedule is shown in Table 1. Following this, cattle were allowed free access to good pasture (all 3 paddocks) for 2 d and then free access to poor pasture for 2 d. Next, animals were randomly allocated to one of 5 groups (n=6 per group). Each group of animals was habituated separately for 12 d prior to testing. This involved giving the group a choice between the feedlot and either: good pasture (2 d), poor pasture (2 d), locked in the feedlot only (4 d), good pasture (2 d) and poor pasture (2 d). Some roughage (pasture hay) was provided whilst animals were in the feedlot to gradually introduce the grain-based ration and prevent acidosis. During habituation, all 3 paddocks of the good and poor pasture were accessible so that animals could learn the paddock conditions.

Testing free choice

Following habituation, the group of animals was tested for free choice to spend time either in the feedlot or one of the pasture situations in the following order: good paddock 1 (2 d), poor paddock 1 (2 d), good paddock 2 (2 d), poor paddock 2 (2 d), good paddock 3 (2 d) and poor paddock 3 (2 d). The habituation and testing procedures were repeated until all 5 groups were tested (i.e. 5 replicates in total). The good and poor paddocks were divided into 3 smaller paddocks to enable greater control over the pasture conditions. During testing of a group, only one of the 3 smaller paddocks was available to the animals at a time. The experiment ran for a total of 20 weeks.

Table 1. Habituation and testing procedures for the feed choices experiment.

Group	Procedure	Treatment	Number of days
All groups	Habituation	All good paddocks	2
All groups	Habituation	All poor paddocks	2
1	Habituation	All good paddocks	2
1	Habituation	All poor paddocks	2

1	Habituation	Feedlot only	4
1	Habituation	All good paddocks	2
1	Habituation	All poor paddocks	2
1	Testing free choice	Good paddock 1	2
1	Testing free choice	Poor paddock 1	2
1	Testing free choice	Good paddock 2	2
1	Testing free choice	Poor paddock 2	2
1	Testing free choice	Good paddock 3	2
1	Testing free choice	Poor paddock 3	2
2, 3, 4 and 5	Repeat above habituation and testing as for group 1		24 d per group

Behaviour

Prior to the commencement of the experiment, animals were fitted with electronic ear tags (Allflex, Brisbane, QLD, Australia) which enabled the recording of when animals entered and exited the feedlot. On the day before habituation, all animals were identified by first shaving the area and then painting a number with peroxide dye along the midline and on each side of the rump (Figure 6). On the day before testing, all animals in a group were fitted with IceTags (IceRobotics, Midlothian, Scotland) to record time spent lying and standing. The behaviours of cattle at the feeder were recorded with 4 video cameras (SCC_B2013P Colour Camera, Samsung, Homebush, Australia) for the duration of the testing for calculation of time spent feeding. A sensor was used to detect low light levels which activated spot lights at night to allow recording of cattle movements.

Figure 6. A steer with a number marking on the midline and both sides of the rump. The steer is fitted with an ice-tag on the hind leg.

Statistical analysis

The purpose of the analyses was to determine if the pasture treatments (good and poor) caused significant differences in the means of the various measurements. Because each animal can influence the others in the group, it was not appropriate to use individual animals as experimental units, therefore group was the experimental unit. The measurements analysed were the feed intake in the feedlot, time spent in the feedlot, at pasture, eating in the feedlot, lying and standing in both environments. Pasture measures included nutritive value and herbage mass on offer. All measures were tested for normality and transformations made where necessary. Feedlot lying was square root transformed and paddock standing was log transformed to improve normality. Data were analysed using ASREML (Gilmour et al., 2006), using a linear model including group (replicate), treatment (poor or good pasture), paddock and treatment by group interactions. Day was confounded by treatment and paddock, therefore paddock was used in the model to account for day effects. Pasture herbage mass was tested as a covariate in the analysis and was found to be non-significant so was not included in the final model. Descriptive statistics of the behavioural measures are shown in Table 2.

Table 2. Descriptive statistics of behavioural measures.

Behaviour (per day)	Mean	Min	Max	St Dev	CV
Time in feedlot (h)	6.01	0.83	15.64	3.07	0.51
Feedlot lying (h)	2.39	0.00	9.78	2.14	0.89
Sqrt feedlot lying (h)	1.38	0.05	3.13	0.71	0.52
Feedlot standing (h)	3.41	0.78	6.19	1.09	0.32
Time eating in feedlot (h)	1.30	0.43	1.93	0.33	0.25
Time in paddock (h)	18.0	8.4	23.2	3.1	0.17
Paddock lying (h)	10.3	1.9	13.6	2.5	0.24
Paddock standing (h)	7.7	5.2	15.3	1.83	0.24
Log paddock standing (h)	0.88	0.72	1.18	0.09	0.10
Group feed intake in feedlot (kg)	61.3	30.0	86.0	14.4	0.23

Results

Behaviour

Means of treatment differences for good and poor pasture are shown in Table 3. There was no difference between time spent in the feedlot under different pasture conditions (P = 0.9). Of the feedlot behaviours, there were no differences in time spent lying or standing between the good and poor pasture treatments. There was a tendency for cattle to eat more in the feedlot when offered poor pasture (P=0.06). Cattle spent more time standing in the paddock when offered good pasture than when offered poor pasture (P=0.02) but lying did not differ between treatments. Treatment x group interactions were not significant for any of the measures.

Table 3. Treatment means of behaviours of cattle when given a choice between good and poor pasture environments.

Behaviour (per day)	Good pasture	Poor pasture	Treatment P value
Time in feedlot (h)	6.0	6.1	0.90
Time at pasture (h)	18.0	17.9	0.90
Feedlot lying* (h)	2.7	2.5	0.87
Feedlot standing (h)	3.5	3.5	0.82
Feedlot eating (h)	1.23	1.37	0.06
Paddock lying (h)	10.0	10.6	0.31
Paddock standing* (h)	8.1a	7.3b	0.02
Group feed intake in feedlot (kg)	57.8	63.2	0.19

*Data presented are back-transformed least square means. a,b different superscripts between treatments indicate a significant difference (P<0.05).

On average cattle spent 25% of their time in the feedlot. Of this time, they spent 44% lying, 57% standing and 22% eating from the feeder. In the paddock, they spent 57% of their time lying and 42% standing. The means for total lying and standing do not always sum to 100% as they are back-transformed. Cattle spent 12.7 h on average lying, and of this 19% occurred in the feedlot and the other 81% at pasture.

The time spent in the feedlot for each group (replicate) in the good and poor treatments is shown in Figure 7. The figure shows that in the first 2 groups, the feedlot time was 15-20% higher in the poor pasture, as hypothesised. However, this difference disappeared in the later groups, and was even reversed in the fourth group; notably, the group by treatment interaction was not significant for any of these effects.

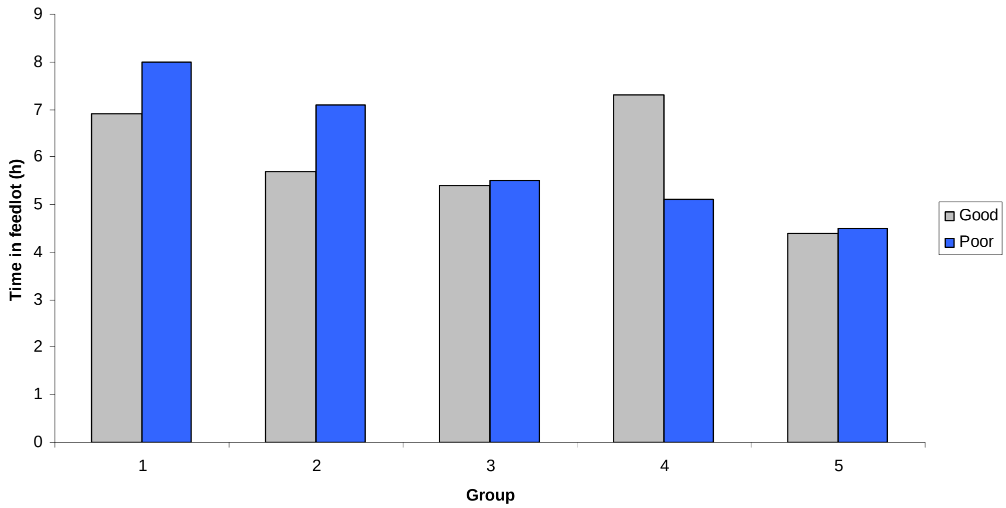

Figure 7. Mean time spent in the feedlot for each group of steers given free choice between good and poor pasture.

The means for behaviours for the 5 groups of cattle are presented in Table 4. There were no differences between time spent in the feedlot or at pasture between groups. Group 4 had a higher feed intake in the feedlot than groups 1, 2 and 5. Group 5 spent less time standing and eating in the feedlot and more time standing in the paddock than the other groups. Treatment x group means are not presented as they were not significant for any measures.

Table 4. Group means for behaviours of cattle when given a choice between good and poor pasture environments.

Behaviours (per day)	Group 1	Group 2	Group 3	Group 4	Group 5	P value
Time in feedlot (h)	7.4	6.4	5.5	6.2	4.5	0.19
Time at pasture (h)	16.6	17.6	18.5	17.7	19.5	0.19
Feedlot lying* (h)	4.7	3.9	2.5	2.5	0.7	0.08
Feedlot standing (h)	5.1a	4.6a	4.3a,b	4.6a	3.9b	0.04
Feedlot eating (h)	1.47a	1.37a	1.32a	1.35a	0.99b	0.002
Paddock lying (h)	9.6	10.6	11.5	10.3	9.3	0.20
Paddock standing* (h)	6.9a	6.8a	7.0a	7.4a	10b	<0.001
Group feed intake in feedlot (kg)	58.3a	54.4a	63.5a,b	73.7b	52.8a	0.002

*Data presented are back-transformed least square means. a,b different superscripts between groups indicate a significant difference ($P<0.05$).

The mean pattern of time spent eating during the day is shown in Figure 8 across groups and treatments. When given free choice, the peak time that cattle prefer to enter the feedlot and eat from the feeder is between 6 and 8 am. Then smaller peaks are shown around 12 to 2 pm and 6 to 8 pm. There was little feeding activity at night between 10 pm and 5 am.

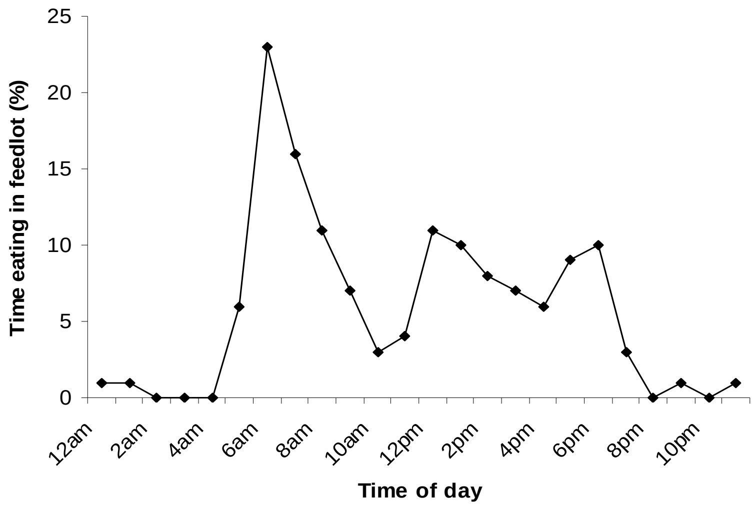

Figure 8. Mean percentage of time steers spent eating in the feedlot when given free choice between pasture and a feedlot. The results are shown at 1-h intervals for a 24 h period.

Pasture and rainfall

The absence of a clear effect of pasture quality on behavourial traits might suggest that the differences between the pastures were small. However, data in Table 5 and Figure 9 demonstrate that for the duration of the study herbage mass was significantly higher in the good pasture environment (P<0.001). Herbage mass was significantly higher for group 4 and lower for group 5 (Table 6). None the less, herbage mass was not a significant covariate for any variable in the analyses. There were no other significant differences between any of the other pasture variables. The total rainfall for each group and treatment is shown in Figure 10. When examined against time spent in the feedlot, there was no clear relationship observed.

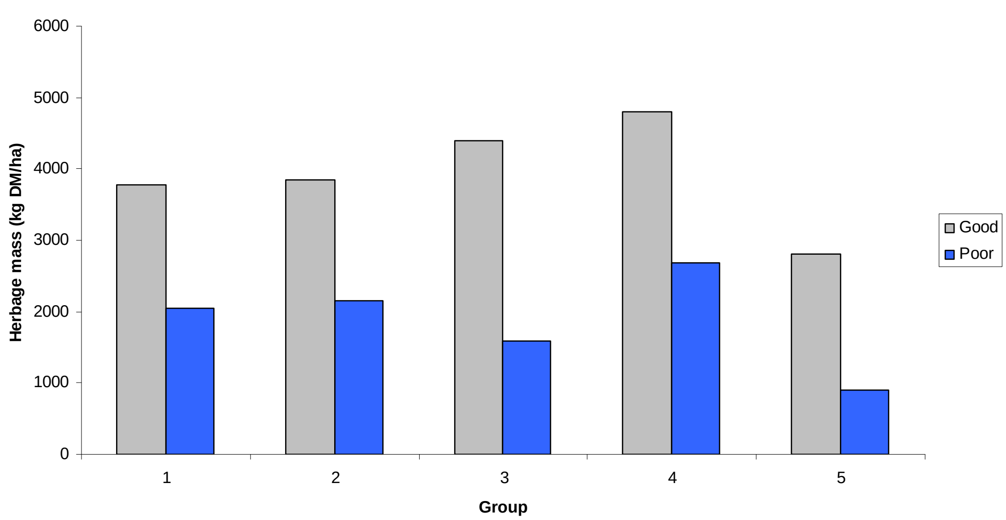

Figure 9. Average herbage mass (kgDM/ha) for groups in the poor and good pasture environments. The groups were tested sequentially over 20 weeks from September 2009 until January 2010.

Table 5. Pasture measures for the good and poor pasture treatments.

Pasture measure	Good	Poor	P value
Neutral detergent fibre (%)	70.2	70.9	0.77
Acid detergent fibre (%)	41.8	42.4	0.92
Crude protein (%)	6.9	5.7	0.11
ASH (%)	8.4	7.6	0.62
Organic matter (%)	92.4	91.6	0.62
Dry matter digestibility (%)	42.6	43.8	0.71
Dry organic matter digestibility (%)	43.1	43.6	0.91
Metabolisable energy (MJ/kg DM)	5.7	5.8	0.84
Herbage mass (kg DM/ha)	3932a	1912b	<0.001

a,b different superscripts between treatments indicate a significant difference (P<0.05)

Table 6. Pasture measures for groups tested sequentially from September till January.

Pasture measure	Group 1	Group 2	Group 3	Group 4	Group 5	P value
Neutral detergent fibre (%)	71.5	70.1	70	70	71	0.77
Acid detergent fibre (%)	43.5		41	43	44	0.93
Crude protein (%)	5.8	6.8	6.5	6.1	6.3	0.70
ASH (%)	9.5	8.4	5	9	8	0.24
Organic matter (%)	90.5	91.6	95	91	92	0.24
Dry matter digestibility (%)	41	42.4	45	44	43.5	0.71
Dry organic matter digestibility (%)	41.5	42.8	44.5	44	44	0.87
Metabolisable energy (MJ/kg DM)	5.4	5.7	6.1	5.9	5.9	0.83
Herbage mass (kg DM/ha)	2937a	3010a	3034a	3696b	1932c	<0.001

a,b different superscripts between groups indicate a significant difference (P<0.05)

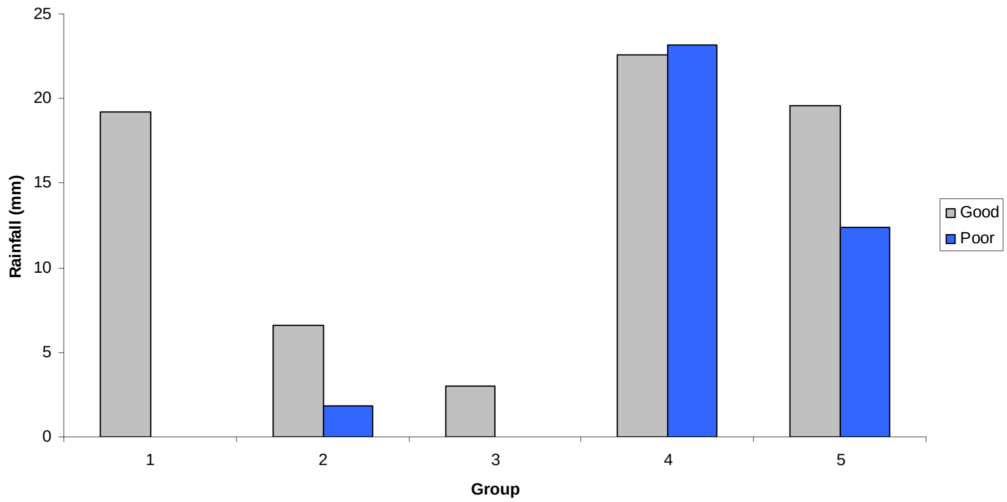

Figure 10. Total rainfall for groups in the poor and good pasture environments.

Discussion

This study showed no effect of pasture availability on cattle preference for feedlot or pasture environments. Our hypothesis was that animals would spend more time in the feedlot when the pasture availability was poor, and this appeared not to be the case. It can be noted that in the first two groups, there was a slight treatment difference (although not significant) as expected (more time spent in the feedlot when there was a choice of poor paddocks), however, this effect was reversed in later groups. As pasture availability may have varied between groups, we examined pasture herbage mass in the various paddocks for different groups and although there was variation between groups, the difference in herbage mass between treatments in the various groups was approximately constant across all groups. Hence the reversal of the effect in later periods can not be explained by decreased pasture availability or quality (within treatment) in those groups. This is consistent with lack of a significant interaction between treatment and group. Some individual observations had a large effect on these differences, e.g. group 4 had two high values for time spent in the feedlot (15 h and 14 h). However, these values were close to 3 SD from the mean and therefore could not really be classified as outliers. The relatively large variation in behavioural trait phenotypes as shown by the coefficients of variation (Table 1) would have contributed to the lack of significance of various effects, as well as to the inconsistency of treatment effects over groups. More observations would have given more precise estimates, but the observed treatment effect was so small that more data would unlikely make much change to the outcomes.

Another reason for the lack of a significant treatment effect could be that cattle consumed their daily nutritional needs with the feedlot diet alone. The recommended daily consumption of the feedlot ration is between 54 to 80 kg per group per day. The average group consumption was 60 kg per group per day which would have met their nutritional needs. Therefore, cattle may have been less reliant on the pasture as a feed source. Although the good pasture contained significantly more herbage mass than the poor pasture, the average herbage mass of the poor pasture was 1912 kg DM/ha which was still within the critical herbage mass recommendations of 700-2900 kg DM/ha for cattle (Bell, 2006).

Time budgets provide an indication of how cattle perceive the feedlot. Cattle spent 25% of their time in the feedlot. Of this time, only 22% was spent eating, therefore cattle were not only entering the feedlot to access food. Cattle choose to enter and eat in the feedlot in the morning and again at midday and in the afternoon. This aligns well with industry practice of feeding cattle in feedlots twice a day, morning and afternoon. Although this is the first study to look at cattle preferences for feedlots vs. pasture, previous studies on indoor housing vs. pasture report that cattle spent 46% of their time indoors, which was related to the preference for shade during the day (Legrand et al., 2009). A study by Krohn et al., (1992), reported that cows spent 28% of the day indoors when given free choice. The differences between studies have been attributed to the type of housing, pasture and climatic conditions. Lying time is a useful indicator of comfort. Although cattle spent a larger proportion of time lying at pasture, they still chose to lie for 44% of the time they were in the feedlot. This suggests that they were comfortable to lie on the feedlot pad and did not find the feedlot environment aversive. In total, cattle in this study spent 12.7 h of each day lying which is within the 12-13 h range that cows are motivated to achieve (Jensen et al., 2005).

There were logistical challenges imposed by the experimental design. As the group was the experimental unit, a greater number of replicates was required which extended the experimental period to 20 weeks. Conducting the experiment over this time frame resulted in additional environmental variation due to seasonal influences on pasture, temperature and rainfall. The different environmental conditions experienced between groups may have influenced the choice of where cattle spent their time. However, the experimental design allowed us to account for some of these time effects by including group and pasture availability as a covariate in the statistical model. Upon examination, there were never any significant interactions between pasture herbage mass, group and treatment which indicated that they had no influence on the treatment effect.

Preference testing enables assessment of animal choice (Dawkins, 1990). However, the preference testing methodology does not inform us of how important the choice is to the animal. In contrast, behavioural demand methodology enables us to determine the strength of an animal's motivation to gain a resource. Future studies using demand methodology such as 1) making animals work to gain access to pasture by say, pressing a lever, or 2) inclusion of a cost to the animal's choice such as locking the animal in the feedlot for 24 h once it enters will enable assessment of the strength of the preference for the feedlot v pasture environment.

The current study deliberately did not include any additional resources in the pasture or feedlot such as shade or improved pasture quality which may influence preference. Future studies could investigate the influence of additional environmental factors and enrichments on cattle preferences.

Conclusions

The results of the current study indicate that cattle preference for feedlot or pasture environments was not affected by pasture availability.

Overall progress of the project

The project is progressing as planned and is on schedule. The next experiment is due to commence in August 2010. This study will test cattle preference for feedlot or pasture environments under commercial conditions.

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Feed analysis

supreme stockfeeds

SUPREME STARTER - Beef

A complete ration pellet formulated for supplementation in the paddock or as a background feed as a safe introductory feed to prevent acidosis and bloat prior to high grain diets.

Animal Suitability **Beef and Dairy > 150 kg (live weight) - *Indicative weights***

Feeding guide

Background Feeding	Feed as a supplement for an extra energy and protein source. Allow either free access to self feeders or provide a ration per head per day.
Introductory Feeding	Feed up to 14 days prior to introducing a fattening ration such as Supreme Cattle Finisher or Supreme Lamb Finisher Pellets.
Complete Feeding	IMPORTANT – when animals are fed in confinement or if pasture is limited, feed as an unlimited feed source or as a ration every day. To maintain a consistent plane of nutrition do not let the pellet supply run out, otherwise take a couple of days to reintroduce pellets.

Feeding rates (per head, per day, indicative rates)

Cattle

Calves, heifers, steers, dry	Up to 2%-3% of bodyweight per head per day e.g. 200kg animal x 2% = 4kg/day
Wet & lactating cows, bulls	Up to 3% of bodyweight per head per day e.g. 500kg animal x 3% = 15kg/day

Sheep

Lambs, wethers, dry ewes	N/A See Ewe & Lamb
Wet & lactating ewes, rams	N/A See Ewe & Lamb

Typical Analysis (Dry Matter Basis)	
Dry Matter	90.0%
Protein	14.0%
NPN	2.2%
ADF	26.0%
NDF	38.0%
Fat	3.0%
ME	11.35 MJ/kg
NE Maint.	1.50 Kcal/kg
Net Energy Gain	1.0Kcal/kg
Calcium	1.2%
Phosphorus	0.34%
Potassium	0.56%
Sulphur	0.18%
Magnesium	0.22%
Copper	16.54 mg/kg
Manganese	31 mg/kg
Selenium	0.2 mg/kg
Zinc	68 mg/kg
Rumensin®	24 mg/kg

Additional Information

⇒ Feed in troughs, feeders or trail on ground

⇒ Ensure sufficient trough space, to minimize competition for pellets

⇒ Ensure supply of fresh, clean drinking water at all times.

⇒ Water consumption will increase during feeding

This product does NOT contain restricted animal material

Features	Benefits
• 9mm diameter.	• Minimal waste
• Available in bulk, 1 tonne and 20kg bags.	• Easy to handle, may be augered
• Contains essential vitamins and minerals.	• Supplies all essential major minerals and fat
• Formulated as a complete ration.	• No other feed additives required
• Contains cottonseed hulls as a source of effective fibre.	• Promotes rumination
• Contains Monensin as Rumensin®	• Improved feed conversion efficiency and

There may be variations of composition, depending on seasonal conditions and raw materials. These specifications are given as a general indication of a typical analysis. Product may contain traces of feed ingredients not specified. Shelf life of this product is limited. It is recommended that the product be used within a 3-6 month period. Store in a cool dry place.

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