2011 Australian Lot Feeders Association Annual Conference

Optimising Bunk Management and Feeding Programs

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Introduction

Bunk management programs should aim to optimise management of nutrient and energy intake; ensuring that daily nutrient requirements are met, that over-consumption of rapidly fermentable carbohydrates by individuals does not occur and that feed wastage is minimized. Controlling feed deliveries is of primary concern; however there are many other aspects of bunk management that should be considered. These include but are not limited to; diet, class of cattle, environment and pen conditions. Ultimately, we aim to reduce intake variations whereby maximising performance and overall profitability of the feedyard.

Bunk management plays a crucial role in defining the initial 14 to 21 days of the feeding period and setting the basis for the remaining days on feed. Everything that we do in this initial phase (starting period) can impact the outcome of the feeding program, and subsequently overall profitability.

There are numerous approaches to bunk management and feed delivery. This paper aims to provide a review of the current industry and research approaches to feed delivery, in particular, timing and frequency of delivery. In addition, a review of various approaches to adapting cattle to finishing rations will be provided.

Bunk Management

Over time we have made some extraordinary advances in bunk management systems. A renowned researcher in bunk management (R.H. Pritchard) uses a quote from Mumfords's 1907 Beef Production text to prove that some aspects of bunk management stand the test of time. The authors cite "as soon as the fattening process begins, the cattle should be fed at certain hours and in the same way. This cannot be varied 15 minutes without some detriment to the cattle. The extent of injury will depend upon the frequency and extent of irregularity...". This is a reminder that cattle are creatures of habit and variations can create problems when feeding high grain diets. No matter what bunk management program you choose to implement, consistency is the key to maximising performance.

Time of Feeding

Feeding patterns of feedlot cattle have been reported in several studies (Gonyou and Stricklin, 1981 and 1984; Stricklin, 1987 and Hicks et al., 1989). The general consensus is that feeding activity is diurnal, with the largest feeding bouts following sunrise and before sunset. Hicks et al. (1989) in a study using 96 British crossbred yearling steers, reported that feeding activity peaked between 6.50am and 7.50am with 47.3% of steers eating. While the afternoon (5.00pm) 36.8% of the steers were observed to be eating (Figure 1), confirming this diurnal nature of feeding behaviour.

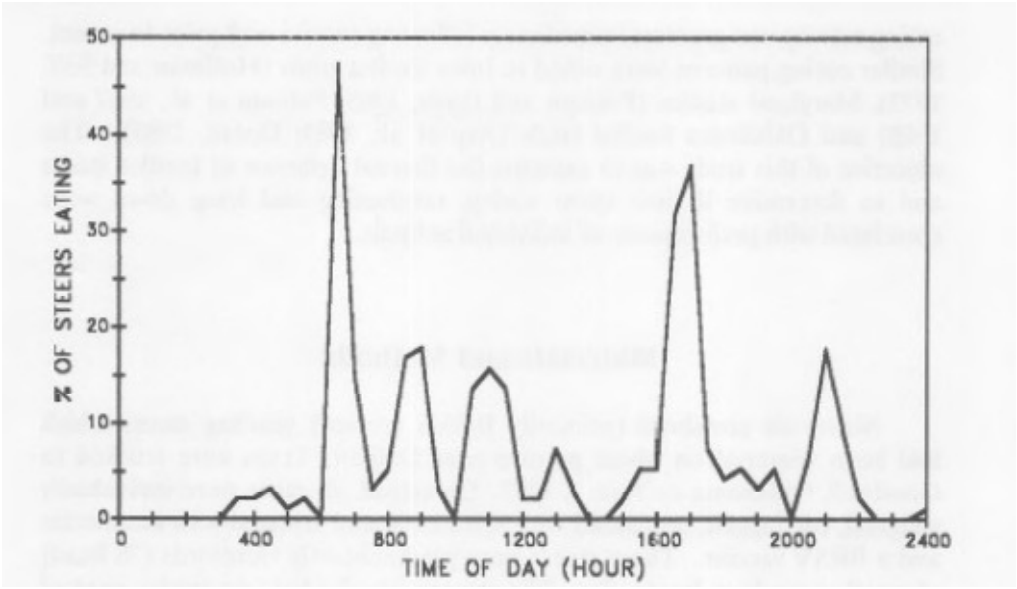

Figure 1. Eating patterns of feedlot steers.

Several researchers, myself included, have investigated time of feeding when feed is delivered once daily. During the summer months radiant energy typically peaks between 12 noon and 2pm, and when these peaks become extreme feedlot animals begin to suffer from heat stress. In addition to environmental conditions, the heat of fermentation (digestion) and the heat increment associated with eating becomes additive to the heat load, increasing the animals energy requirement for maintenance. In this instance, feed deliveries occurring in the afternoon or early evening would appear to be an advantage as heat generated from eating would occur during the evening hours when the animal's ability to dissipate heat is greatest.

In a study conducted by Reinhardt and Brandt (1994), lightweight calves were limit-fed to gain 1.0kg per day. In this trial cattle were fed either in the morning (8am) or evening (8pm). Evening feeding increased (P <.05) ADG by 18% despite cattle being fed the same caloric intake (Table 1). This research was confirmed by Knutsen et al., (1994) where they found no difference in DMI from morning (7.30am) versus afternoon (4pm) feeding but discovered a significant difference in ADG and feed efficiency (Table 2.).

Table 1. Summer performance of cattle limit fed in the morning or evening.

	Morning	**Evening**
DMI, kg	4.22	4.26
DMI, % BW	2.3	2.3
ADG, kg[a]	0.75	0.89
Feed/Gain[bc]	7.46	6.37

[a] Means differ (P<.02)
[b] Means differ (P<0.6)
[c] Analysed as gain/feed

Table 2. Feedlot performance of steers fed at different times of the day during summer

Item	Morning	Afternoon
Initial Weight, kg	372.9	370.1
Final Weight, kg[a]	536.1	553.8
ADG, kg[a]	1.93	2.18
DMI, kg	10.40	10.36
Feed/Gain[a]	5.36	4.73

[a] Means differ (P<.05)

Conversely, in the winter months by shifting the heat of fermentation to the afternoon/evening we may be able to take advantage of the additional heat production. In a 56 day winter study (Holt et al, 2004; Table 3.) investigating feeding time on feedlot performance of limit-fed growing steers, researchers concluded that afternoon (3pm) deliveries not only improved performance but those steers were able to maintain body temperature more effectively than those fed in the morning (9am).

Table. 3. Feedlot performance of limit-fed growing steers fed at different times of the day in winter.

	Morning	Afternoon
Initial Weight, kg	298	297
Final Weight, kg	377	385
ADG, kg	1.42	1.56
DMI, kg	7.37	7.37
Gain/Feed	5.19	4.72

To summarise, the research clearly defines benefits and advantages of afternoon feeding schedules in both summer and winter. Daily production efficiencies may be enhanced by feeding later in the day as feed will remain fresher in the evening hours compared to daylight hours with lower temperatures an no sunlight. As mentioned earlier, cattle typically eat more in the evening hours, meaning this feed would be a fresh delivery. Another advantage to the afternoon feeding schedule is the feed will be available for the morning eating episode (sunrise) regardless of cattle activity and feed delivery schedules as the clean bunk occurs around midday. Regardless of season, there appears to be energetic efficiencies from delivery feed in the afternoon/evening compared to morning as ADG is improved even though cattle are offered the same amount of DMI.

Feeding Frequency

A review of the current research on frequency of feeding yields conflicting results. Early research by Hanke et al. (1981) reported no advantage to feeding twice a day. Other researchers (Pritchard and Knutsen, 1995) have observed variable responses. In two experiments, yearling cattle where either exposed to once (7.30am) or twice (7.30am and 4.00pm) a day feeding (Table 4.). In Exp. 1, a 7% improvement in ADG was noted along with a 10% advantage in feed efficiency for cattle fed twice daily. Interestingly, in Exp. 2, no advantage was observed for those cattle fed twice daily feeding in ADG or feed efficiency.

A small decrease in DMI (2%) was reported for the twice daily cattle versus those fed only once per day. The reasoning for the inconsistent response is unclear, however, the researchers suggest that multiple feedings do reduce the magnitude of feeding errors, and the opportunity for binge eating is reduced.

Table. 4. Influence of feeding frequency on yearling steer performance

		Once Daily	Twice Daily
EXP 1	ADG, kg	1.94	2.07
	DMI, kg	10.40	10.10
	Feed/Gain	5.36	4.89
EXP 2	ADG, kg	1.39	1.40
	DMI, kg	8.89	8.70
	Feed/Gain	6.39	6.21

Recently, Soto-Navarro et al. (2000) studied the impact of multiple feed deliveries versus once daily. This research primarily investigating the influence of feed delivery fluctuations and the influence on acidosis. As feed deliveries were fluctuated by 10%, increasing the feeding frequency appeared to stabilise the rumen environment. It is critical with once daily feeding to reduce intake variation by consistent feed deliveries, and if this is unobtainable then multiple feedings may improve performance.

Personal observations from both the United States and Australia, has consistently seen improvements in production efficiency and rates by twice daily feeding. Feed efficiency responses are generally increased by 10%. In my opinion, these improvements come from the ability to better manage intake variation within pens and control digestive concerns.

When considering feeding frequency in a feeyard operation several factors need to be considered;

a) Bunk capacity – is there enough capacity in the bunk to enable once daily feeding
b) Ration type – does the ration ingredients cause high or low separation
c) Stable feeds – does the ration contain high moisture ingredients
d) Weather
e) Type of cattle – starters versus finishers

It is my opinion that once daily feed deliveries should be considered if the following parameters are met;

- Bunk capacity is large enough to accommodate feed deliveries in one drop.
- Ration contains low separation feeds whereby the ability of the cattle to sort the ration is low.
- Ration does not contain a lot of high moisture feeds eg. Wet Distillers grains, silage
- Batching logistics – ration batch is too small to allow for multiple deliveries
- Weather is relatively stable eg. minimal precipiatation
- Stable cattle – eg. finishers

Twice daily feed deliveries should be considered if the following parameters are met;

- Bunk capacity is small.
- Ration contains high separation feeds.
- Ration contains a lot of high moisture feeds.
- Unstable weather.
- Unstable cattle eg. starters

In summary, by increasing the feed delivery from once to twice a day may improve performance by allowing individual animals more access to feed and reducing intake variations within a pen. It also allows access to fresher feed over multiple feedings. Another advantage of multiple feed deliveries means than any feeding, mixing or allocation errors will be of a lesser magnitude than when feeding once daily. There is limited research available on feeding beyond twice a day and thus far we see no additional advantages to feeding frequencies beyond twice daily.

An inherent problem with once daily feeding programs in large feedyards is that bunks are often read at a single point in time. Since not all pens can be fed at the same time it makes predicting when pens that are fed later in the day will have a clean bunk. Under this program it is advantageous to manage the yard in zones so that bunks may be managed more accurately.

Adaptation to Finisher Diets

There are many considerations when initiating cattle on feed, and for the most part at this point future plans don't matter. During the first few weeks you cannot get cattle fat but you can contribute to increases in morbidity and reduce the ability of animals to recover. When describing the importance of feed intake in the starting phase it is critical to note: Sick cattle don't eat and cattle that don't eat get sick. To ensure that cattle remain healthy and maintain a level of intake typical starter programs involve the use of a large percentage of roughage. However, per unit of energy, roughage can be the most expensive ingredient in the feeding program (Eng, 1995). As nutritionists we must develop a feeding program that optimises cost of gain in both the starting phase and finishing phase. As such, many feeding programs have focused on reducing the amount of roughage incorporated into the starting phase. To minimise digestive disorders on these lower roughage programs bunk management become extremely critical.

The following is a review of several programs available to adapt cattle to finishing diets.

<u>Traditional</u>

The most widely recognised program is the traditional, where cattle are initially fed a 25-30% roughage based diet and over a period of 14 to 21 days the roughage is slowly decreased to obtain a finisher diet containing anywhere from 6 to 15% roughage on a dry matter basis. Under this program initial feed intake is offered at 1.5 to 2.0% of BW. Ideally, the more transitional steps that occur in the starting phase, the better the impact on animal performance.

However, the inefficiencies involved in milling and delivering multiple rations makes this impossible to manage. It is most likely and more feasible that a 3 to 5 step program is used.

Restricted Intake

The Restricted Intake program involves cattle being fed the final diet (88 – 92% concentrate) from day 1 or 2, with dry matter intake being restricted to 1.5 to 1.75% of BW. Dry matter intake is increased gradually until *ad libitum* intake is achieved. DMI increases are generally in the order of 0.25 to 0.50kg/head/day. The advantages of this program are economic efficiencies of limiting roughage handling and usage and energetic efficiencies of the cattle when restricted on intake. It should be known that an increased commitment to bunk management needs to be employed when considering this option.

Limited Maximum Intake

This program has similarities to the restricted intake program. Cattle are limited on intake of a finisher ration based on multiples of maintenance energy requirements. Cattle are fed the final diet (88 – 92% concentrate) from day 1 or 2. In contrast to the RI program, intake is restricted to 2.1, 2.3, 2.5 and 2.7 times net energy requirements for maintenance based on initial BW and are stepped up weekly to a goal of maximum DMI by 28 days. The advantages of this program are in the ability to predict consumption and enabling target intakes. This certainly can be an advantage when training new feed callers.

Two Ration Blending (2RB)

This program utilises two rations as the name suggests. Various proportions of a typical starter and finisher ration are offered daily. Initially, a starter ration is fed for the first 5 days and then cattle are offered a percentage of starter and a finisher from day 6 and are slowly transitioned over to the finisher by reducing the percentage of the starter diet fed (Table 5.). The two rations are fed at separate times in the day, with the starter ration being the first drop. Feed can be delivered twice or three times per day. The advantage of this program relies on smaller incremental changes in energy and forage content, whereby reduces digestive disturbances and intake variations. Improved economic efficiencies should be observed as minimal rations are milled and feed trucks can be managed more effectively. As with most adaptation programs, the disadvantage is managing feed deliveries as timing can be critical. It should be noted that this program assumes that each animal is consuming equal portions of each ration daily.

Table 5. Example of a two ration blending program of adapting cattle to high concentrate diets with three feed deliveries.

Feeding 1		Feeding 2		Feeding 3		
Ration	**%**	**Ration**	**%**	**Ration**	**%**	**Days**
1	33	1	33	1	34	3
1	45	4	15	1	40	3
1	35	4	30	1	35	3
1	30	4	45	1	25	3
1	40	4	30	4	30	3
4	33	1	33	4	34	3
4	45	1	15	4	40	3
4	33	4	33	4	34	3

Impact on Adaptation Program on Performance

In a research study investigating restricted intake (Bierman and Pritchard, 1996), cattle were adapted to a 92% concentrate diet by either allowing *ad libitum* access to a 45, 65, 75, 82% concentrate diets over 11 days or by restricting intake of the final diet to 1.74% of body weight followed by gradual increases until *ad libitium* intake was achieved. Over the initial 29 days, restricted intake cattle consumed 20% less and were 19% more efficient (Table 6.). Over the entire feeding period (121 days) ADG were similar for both treatments, however restricted intake cattle were 11% more efficient.

Table 6. Initial and cumulative feedlot performance of yearling feedlot steers adapted to high concentrate diet by either restricted intake or traditional methods.

	Restricted Intake	**Traditional**
	Day 0 to 29	
Initial BW,kg	391.9	392.4
Day 29 BW, kg	487	491
ADG, kg	3.28	3.40
DMI, kg	8.99	11.3
Feed/Gain	2.75	3.4
% Slick bunks	90.7	42.7
	Day 0 to 112	
Final BW, kg	602	604
ADG, kg	1.74	1.75
DMI, kg	10.69	11.97
Feed/Gain	6.15	6.90
% Slick bunks	69.3	39.7

Weichenthal et al. (1999) found similar results when adapting Angus crossbred steers (383kg) to finishing diets by either traditional or restricted intake methods. Over the entire 123 day feeding period cattle fed the restricted intake consumed 5.8% less and were 7.7% more efficient.

Recently, Choat et al. (2002) reported results of two experiments involving feed restriction as a method to adapt cattle to finishing diets. In the initial experiment yearling steers (418kg) were utilised whilst in the second experiment lighter weight steer calves (289kg) were used. No difference in feed efficiency or ADG was observed for yearling steers, however a decrease in DMI (22%) was observed for restricted cattle vs traditional. In the case of lighter weight cattle, restriction decreased ADG 8% with no impact on feed efficiency.

Bartle and Preston (1992) used the limited maximum intake method to adapt cattle to finishing regimes by limiting DMI to 2.1, 2.3 2.5 and 2.7 by maintenance or limited DMI to 2.3, 2.5, 2.7 and 2.9 by maintenance. During the initial 28 days cattle that were started at 2.1 times maintenance consumed 6% less and appeared to be more efficient than cattle started at 2.3 times maintenance or traditionally. Over the entire feeding period (approx. 115 days) cattle initial limited to 2.1 times maintenance tended to be more efficient and had a greater ADG than other treatments (Table 7.)

Table 7. Effects of limited maximum intake on steer performance.

		Initial limited intake level	
	Traditional	2.1 x maintenance	2.3 x maintenance
Initial BW, kg	371	370	371
Final BW, kg	523	532	529
0 to 28 days			
ADG, kg	1.70	1.73	1.66
DMI, kg	8.6	8.1	8.2
Gain Efficiency, g/kg	197	214	201
Overall			
ADG, kg	1.35	1.44	1.35
DMI, kg	8.3	8.5	8.3
Gain Efficiency, g/kg	163	170	162

A more recent study (Holland et al. 2007) evaluating not only the performance of various adaptation programs (tradition, restricted intake and limited maximum intake) but also investigates the impact on health. Average daily gain was greatest for restricted intake calves, with traditional being intermediate to the limited maxiumum intake method (2.58; 2.49 and 2.34 kg/day, respectively). No significant differences were observed in feed efficiency. In the case of morbidity, traditional cattle had higher total morbidity, along with total mortality and case fatality rates as compared to restricted intake and limited maximum intake (Table 8.)

Table 8. Morbidity and mortality of steers on various programs for adaptation to high concentrate diets.

	Traditional	**Restricted Intake**	**Limited Maximum Intake**
Total Morbidity	45.94	33.97	29.64
Second treatments	22.95	15.18	18.52
Third treatments	4.48	1.45	2.24
Total Mortality	4.48	0.72	1.48
Case fatality rate	7.66	1.52	0
DOF to 1st treatment	10.91	12.79	7.21

The authors concluded that extending the period during which a higher roughage diet is fed or limiting the maximum intake during the adaptation period can reduce morbidity in newly received feedlot steers. Conversely, Brown et al., (2006) in his review indicates that based on observations from accumulated data on pens of cattle (Peter, 1995; Preston, 1995), feed intake is commonly reduced if cattle are allowed *ad libitum* access to feed between day 5 and 14 (when appetite increases rapidly). This recent research dispels a common myth that cattle restricted on intake during the adaptation phase will be more likely to have an increase incidence of morbidity. In fact, these studies suggest the opposite is true, whereby cattle limited on intake not only performance better but are healthier.

The two ration blending approach to adapting cattle to finishing regimes is relatively new and as such limited research data is available. Two research trials conducted recently (Burken et al. 2010; Christensen et al., 2011) have reported differing results. In the 2010 study utilising steers no differences were observed in the two ration blended program as compared to the traditional method.

However, the 2011 trial utilising heifers reported a increase in DMI in the first 28 days for the two ration blended program as compared to traditional, although no differences were seen over the entire feeding period. Both research studies indicate that the two ration blended program can be substituted for the more traditional method without any impact on performance.

Summary

Controlling intake variations is the key to success of adapting cattle to finishing programs and bunk management. In an effort to reduce cost of gain varying adaptation programs involving feed restriction of high concentrate diets are becoming increasingly common. Not only do these programs improve feed efficiency but also may reduce handling and labour cost associated with high roughage diets. In the case of the two ration blended program, the reduction in rations to be milled and delivered can improve feedlot operational efficiency. It should also be noted that with most of these programs comes an increased management requirement for bunk management. At present there is no research data on these programs under Australian short-fed conditions. Based on interim results from the research available it would seem feasible that either the restricted intake or limited maximum intake program should improve efficiency and could be substituted for the more traditional approach under Australian conditions.

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