Feeding Strategies to Improve Feed Efficiency
for Beef and Holstein Feeders

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The primary goal of a feedlot operation is to efficiently convert pounds of feed into pounds of carcass weight. The top five factors that affect feedlot profitability are purchase price of cattle, sale price of the cattle, cost of feed, feed efficiency of cattle, and average daily gain of cattle. Of these five factors, feed efficiency can be most easily controlled by producers and can be improved even after the cattle purchased and rations determined.

Before the feed is delivered the cattle

Several strategies can be implemented can improve feed efficiency in a feedlot. One of the most important strategies is to start before the feed is even fed to the cattle. Feed losses can be significantly greater than other strategies discussed here. Feed losses can occur from storage, mixing, transportation, wind, weathering, and pests. Feed costs represent the greatest proportion of expenses, therefore re-evaluating ways to reduce feed costs is advisable.

Shrink

Feed shrink represents the amount of feed produced or delivered on that farm that is never consumed. Feed wastes can account for 2%, to in extreme cases, 20% of feed provided to animals. Several factors can affect shrink such as storage losses, inaccuracy in delivery of feed, animal feed waste, variation in feed nutrients, mold, and bunk management.

Methods of feed storage can vary the types and amount of shrink loss. Generally, feed losses can differ from 3 to 7% for dry ingredients and 15 to 35% for wet ingredients. In Table 1 are some of the typical storage losses that can occur just during storage. Silage losses are usually the result of spoilage that occurs on the top and sides of a pile, heating of silage, and drainage of liquids from the pile. Improper face management can also significantly increase loss. Some loss is unavoidable, but the goal should be to minimize these losses. Moldy sections of silage should be discarded and not fed, because this could negatively affect intake and gain. Silage that heats up in the bunk loses nutrient value and become less palatable. This may be less of a concern on cold winter days, but cattle should not be forced to eat silage left in bunk for more than a couple of days.

Birds and Rodents

Birds and rodents are often overlooked on their effects on feed losses and quality. Not only can these pests carry diseases, they also consume feed, which can impact the pocket book. Previous research at Kansas State University reported starlings consumed about 2 lb of feed per month and flocks can range from several hundred to several thousand birds. If a flock is 300 birds this would amount to 600 lbs of feed. Therefore, livestock producers should develop plans for controlling birds and rodents in order to reduce feed losses. Here are some management tips to consider in controlling birds and rodents:

- Keep feed storage areas clean and avoid feed spills
- Trim weeds and tall grass around buildings and bunks, which provided habitat for rodents.
- Store grain in pest-proof facilities such a bins
- Minimize the rafters in which birds can perch

- Use feed which starlings are unable to consume (greater than ½ inch diameter), if using feed smaller than this, mix it well into diet to limit starling access.
- Reduce feed left in bunk through slick bunk management
- Reduce water level in waterers to 6 inches below the top
- Use frightening devices or toxicants to move or reduce population

Table 1. Percent feeding loss by storage system

Storage system	Feeding Loss (dry matter %)
Commercial feed mill	0.3-0.7
High moisture corn	2-9
Chopped alfalfa hay	4-10
Soybean meal pushed commodity shed	8-9
Wet distiller grains storing in bags or bunker	7-17
Dried distillers grains- bulk bin	3-6
Dried distillers grains – commodity shed	7-10
Dry grains – bulk bin	2-4
Dry grains – commodity shed	4-7
Bunker/Silage Bag (less than 5"/d)	11
Bunker/Silage Bag (more than 5"/d)	5
Tower silo (haylage)	11
Tower Silo (corn silage, whole plant)	4

Management of feed loss

In order to start to manage shrink losses, a producer must first observe and measure the feed losses in his/her operation. Purchasing a scale to weigh feed ingredients and rations is an investment, which can be paid in savings from reducing feed losses. If a producer is already using a total mixed ration and has a scale, accurate measurement and mixing of diet ingredients are important to insure all cattle are delivered a consistent feed and to minimize feed losses. A properly mixed ration and proper bunk management can reduce feed sorting by the cattle. Reduce variation in feed ingredients and diets by inspecting and testing purchased and harvest feeds.This is even more critical when purchasing feed that can vary in dry matter such as silages and in nutrient content such as by-products. Once a producer is able to identify areas where feed losses are occurring on the farm, he/she can then make adjustments in order to reduce these feed losses.

Bunk Management

Bunk management is critical for reducing feed losses, and can also impact cattle intake and feed efficiency. Feedlot producers often struggle to maintain consist feed intake with little variation, especially if they are not using bunk management. Managing feed delivery is not only critical to cattle eating out of bunks but to cattle eating from self-feeders. Poor bunk management, often results in greater fluctuations in cattle feed intake, which can lead to greater incidence of digestive disorders, greater feed losses, and reduced feed efficiency.

Self-feeder should not be used because a person does not want to manage bunks and look at cattle on daily basis. Self-feeders may reduce some labor cost, however cattle will have higher cost of gains. Bunk management guidelines for self-feeders include

1. Never let the feeder go empty
2. Feeder space should be 4-6 inches per head
3. Minimize fines
4. Add fiber or provide roughage at 1-2 lbs/hd/d

Feed consumption should be estimated on a daily basis and observations made each day that all cattle are eating. This can help identify fluctuations in intake, which otherwise would be hard to identify. Cattle, which are finished on self-feeders, do require more pounds of feed per pound of gain and this can vary from 7 to 8 pounds of feed per pound of gain, depending on diet and level of management.

Bunk management is defined as matching the amount of feed delivered to the amount of feed an animal can eat (handle) by Dr. Pritchard at South Dakota State University. Good bunk management can be more of an art than a science. Principles of good bunk management can be learned, but it does require practice and experience. The goal of a finishing program is to provide consistent amounts of feed at consistent times. Cattle are creatures of habit and disruptions in their routine can lead to disruptions in feed intake. This can be used to a producers advantage in developing a bunk management protocol, therefore minimizing changes in their environment, reducing stress, and delivering feed consistently is critical.

Studies have been conducted at South Dakota State University comparing ad libitum (low management) feeding programs and programs managed for slick bunks. Data from one trial is presented in Table 2. Managing bunks to be slick each morning resulted in a reduction of feed intake by 12% without any impact on growth performance. In this study, feeding cattle for ad libitum intake resulted in greater variation of feed intake, and in more cattle with a very low ADG towards the end of the finishing period (<1.0 lb/d). This was most likely due to individual animals experiencing acidosis, which is detrimental to feed efficiency.

Table 2. Effect of management system on feedlot performance and carcass traits

	Ad libitum	**Managed**
Initial wt, lbs	864	864
Final wt, lbs	1332	1327
ADG, lbs/d	3.86	3.84
Dry matter intake, lbs	26.4	23.6
Feed to Gain, lbs	6.57	7.35
Clean bunks, %[1]	40	69
Carcass weight	822	822
Dressing, %	61.8	61.9
Fat thickness, in	0.43	0.41
Marbling score[2]	5.31	5.67

[1]Percentage of days when no feed was present in bunks in the morning.
[2]5.0 = small (USDA Low Choice); 6.0=modest (USDA Average Choice)

Typically producers think a slick or empty feed bunk in the morning means that gain has been lost, but this is not necessarily true. If animals are restricted too much this will result in reduced average daily gains, but a slight restriction in intake can result in improved feed efficiency. Although average daily gain is not maximized, the improved in feed efficiency can make up the difference. Furthermore, over-feeding cattle can be more detrimental, because of the resulting wider variation in intake, which can lead to digestive disorders (Figure 1).

A producer cannot manage what he/she does not measure, therefore keeping records is a critical. The first step is to keep a record of how much feed is delivered each day and step two is monitoring how much feed is left in bunk prior to feeding. This information is important to decide what should be fed in the following days. If a bunk is slick the next morning, how much

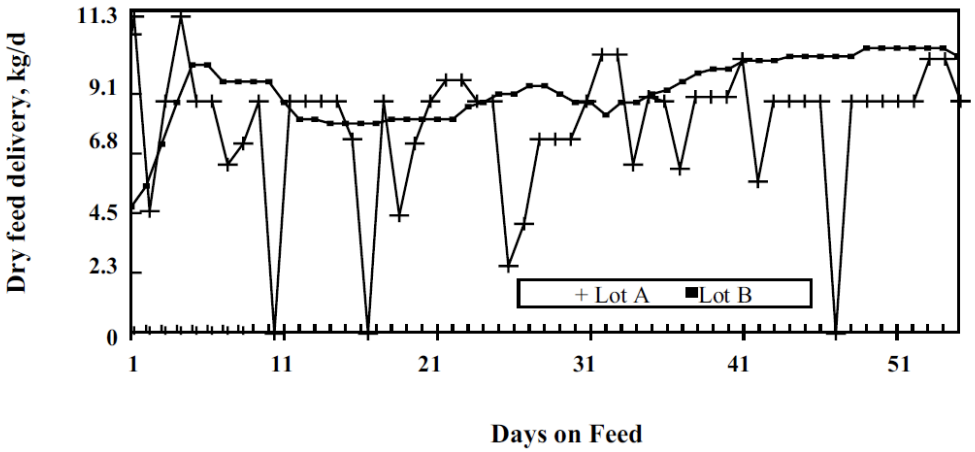

Figure 1. Feed deliveries expressed as dry matter per animal daily for representative pens. Lot A was offered ad libitum access to feed; Lot B was fed using a slick-bunk management system. (Prichard and Bruns, 2003)

more feed should give? If a bunk is half full, how much should you feed the calves today? Without a good idea of what has happened the past couple of days, it can be hard to make a good decision on what to feed today. Developing a bunk scoring system can help make these decisions easier. A few different bunk scoring and management protocols have been developed, but a producer must find what works best for them. Table 3 is one example of bunk management protocol.

Table 3. A bunk management protocol to determine daily adjustments to feed delivery

Previous day's PM feed call	**Today's AM feed call**	**Adjustment, lbs/hd (lbs/hd left in bunk)**
Feed remaining	Feed remaining	No change (< 1 lb); -0.5 (1 lb); -1 (2 lb); -2 (3 lb); -3 (4 lb); -4 (5 lb)
Feed remaining	Slick	+0.5
Feed remaining	Slick (but increased deliver yesterday)	No change
Feed remaining	Slick (but decreased delivery yesterday)	+1/2 of yesterday's decrease
Slick (1st day)	Slick	+1
Slick (2nd day)	Slick	+1 lb per head regardless of any previous increases

Krehbiel and Holland (2009)

Feeding Programs to Improve Feed Efficiency

Forage level and corn processing

The rumen can break down less digestible forages through fermentation in cattle, however this is not very efficient. Processing forages, such as chopping, increases digestibility, which in turn can improve feed efficiency. As the forage proportion decreases and the grain proportion increases in the diet, the ability of the calf to convert feed into carcass weight more

efficiently improves. Cattle can consume a 100% grain diet, but in order to keep the rumen functioning properly and reduce the risk of digestive disorders, forages should represent at least 5-10% of dry matter intake. Together with improving feed efficiency, feeding a high-grain finishing diet can also reduce manure output (Table 4), labor for handling of bulky forages, and feed losses.

Table 4. Manure output of cattle fed different forage concentrations

	Weight Lbs/d	Volume Cu ft/d	Days on Feed	Total Manure Lbs/hd
High Forage (50%)				
Steer, 750 lbs	62	0.984		
Steer, 1100 lbs	92	1.48	175*	13,475
High Concentrate (90%)				
Steer, 750 lbs	54	0.871		
Steer, 1100 lbs	80	1.29	100**	6700

*ADG = 2.0 lbs/d
**ADG = 3.5 lbs/d

Grains, which contain a greater concentration of starch than forages, rapidly ferment the rumen. Starch fermentation rates vary depending on type of grain and processing method (Figure 2). Processing grains to reduce particle size can improve digestibility and starch fermentation. Reducing particle size and increasing starch fermentation can maximize efficiency, but it may be at the cost of increasing incidence of digestive disorders such as acidosis and bloat. A common question is to what extent should corn be processed?

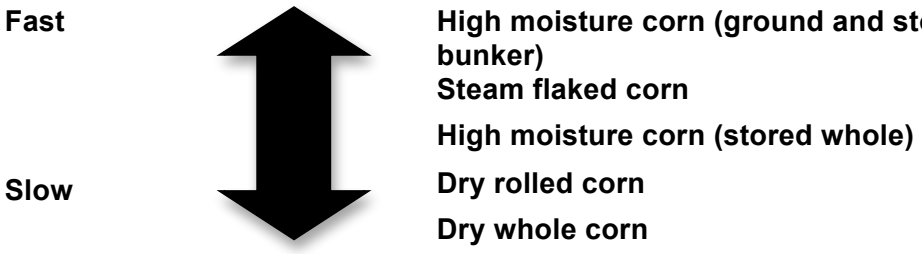

Figure 2. Effects of corn processing on relative rates of ruminal starch digestion (Stock and Britton, 1993).

In most cases the difference in digestibility between whole shelled corn and dry rolled corn is 5% or less. Grinding and rolling are two of the least expensive methods for processing corn. However, the decision to roll or crack corn must be made on the basis of purchase price or price of equipment and labor to process the grain. In finishing diets containing less than 20% of ration as roughage, whole corn may allow for more ideal rumen health and reduce the incidence of acidosis. Dry whole corn is also recommended for use in self-feeders for this same reason.

High moisture corn (whole and processed) does have a faster starch fermentation rate results in greater feed efficiency compared to dry-rolled, cracked, or ground corn. No particular advantage has been observed in blending whole and ground corn, however blending of whole corn and high moisture corn warrants consideration (Table 5). The two different fermentation rates of these corn-processing methods complement each other in the rumen, allowing for greater digestibility and improved feed efficiency. Again, the decision to process corn should be based on the efficiencies gained from processing compared to cost of processing.

Table 5. Effect of Mixing High Moisture and Dry Whole Corn in Finishing Diets

	HMC:DRC			
	100:0	**75:25**	**50:50**	**0:100**
First 28 d				
DMI, lb	20.7	20.2	20.6	20.7
ADG, lb/d	3.24	3.37	3.33	3.11
F:G	6.3	5.9	6.1	6.5
To Slaughter				
DMI, lb	20.5	20.5	21.0	22.2
ADG, lb/d	2.91	3.00	3.00	2.84
F:G	7.0	6.7	7.0	7.8

*Stock et al., 1987

Limit feeding/Programmed Feeding

Programmed/Limit Feeding: A feeding routine, which is used to achieve a specific rate of gain at a restricted feed intake.

Limit feeding is more commonly used in growing rather than finishing diets. A growing diet may be used for calves (not yearlings), which enter the feedlot at a lightweight and are small framed, because it is expected these cattle could finish at lighter weight (< 1050 lbs) which will likely result in discounts at sale time, because of light carcass weights. Therefore cattle are placed on a lower energy diet in order to achieve a moderate growth rate (2 to 2.5 lbs/d) to increase frame and muscle with minimal external fat accumulation. High grain diets (60-80% grain) can be limit-fed at a reduced intake to obtain a desired gain. Some advantages of feeding a limit-fed diet include:

- Improve diet digestibility
- Improved feed efficiency and lower cost of gain
- Reduced manure output
- Eliminate feed losses in bunk
- Increase muscle growth and decrease fat accumulation
- Reduce variation in feed intake
- Aid in predictability of marketing plans

Roughage level in the diet can be determined by how much risk the producer is willing to accept. Intakes can range from 70 to 90% of full-feed diet to target gains between 2 to 3 lbs per day. Even with greater corn costs over the past couple years, corn grain can still be one of the least expensive feed sources per unit of energy compared to forages. Research at The Ohio State University demonstrates that cattle, which are limit fed corn to achieve gains of 2.0 pounds per day until they reach 750 pounds have similar performance during the finishing phase (full feed on a high grain diet) as cattle fed a corn silage growing diet prior to finishing. The limit fed steers were fed 9.2 lb per head per day of whole shelled corn (1.3% of body weight) plus 2.2 lb per head per day of a 37 percent protein supplement (Murphy and Loerch, 1993; Loerch et al., 1995).

Limit feeding can also be used for finishing cattle diets to improve feed efficiency and to reduce external carcass fat. In finishing diets, a program is followed in which intakes are adjusted weekly, biweekly, or monthly to maintain the same growth rate. In trials conducted at Ohio State University, cattle were fed 10-20 percent less feed than counterpart steers allowed to eat free choice. Cattle were all fed to the same final weight (1,150 pounds). Each 10% decrease

Table 6. Feedlot performance of calves fed corn-silage or limit-fed corn rations.

		Limit-fed high Moisture corn	
	Corn Silage	**Whole**	**Rolled**
ADG, lbs/d	2.21	2.16	2.26
DMI, lbs	13.4	10.1	10.1
F:G	6.12	4.74	4.51

*84 d growing period
**Loerch, 1992

in intake,decreased rate of gain by about 0.2 lb per day. As a result, it took the limit-fed cattle 15-25 day longer to get to market weight. However, the limit fed cattle used 100-250 pounds less fed to achieve market weight even though they were on feed longer. There were also advantages to limit feeding in terms of carcass composition. Limit fed cattle had carcasses with 15-25% less external fat than the full fed cattle without decreasing marbling score or quality grade.

In order to implement a limit-feeding program, producers need facilities with good fences, adequate bunk space, and equipment to weigh and mix complete ration. Adequate bunk space is critical to make sure all cattle can eat at the feed bunk at the same time. If the producer has the ability to sort cattle into more uniform groups of cattle by weight, this will allow more accurate formulation of diets. Producers need to understand the Net Energy System or should consult a nutritionist to formulate diets. In conclusion, it may not be in the best interest for the cattle to determine their own intake, whereas when the producer controls intake this can result in less feed waste, improved feed efficiency, and greater profitability.

How do these strategies apply to Holstein steers?

Most of the strategies discussed here can be applied to Holsteins. Holsteins and other dairy breeds are less efficient at converting feed into pounds of carcass weight, therefore strategies, which improve feed efficiency, are even more critical to profitability. For example, feeding Holsteins a high-forage diet will increase the amount of days on feed for the animal to reach a desirable finished weight. An example projection, comparing dairy steers on high forage verses high grain finishing program is found in Table 7. In addition dairy steers are

Table7. Economic projections for two types of dairy steer feeding strategies.

	400-1300 lbs	
	High Forage[1]	**High Grain**
Days on Feed	353	300
ADG	2.50	3.00
F:G	7.7	6.0
Total Feed	6930	5400
Feed cost:gain, $/lb	$0.58	$0.57
Total Yardage	124	105
Return, $/hd[2]	(66.19)	(28.08)
Breakeven Price	68.45	77.98

[1]High forage diet = 20% corn, 11% supplement, and 70% corn silage on DM basis; High grain diet = 75% corn, 10% supplement, and 15% corn silage
[2]$85.00/cw for 400 lbs calf and $80.00 cwt for 1300 lb steer

large framed and do not require a growing phase, because those cattle will finish at too heavy of weight (>1500 lbs) and require more days on feed. In most situations, the additional carcass weight, does not compensate for the additional costs due to increased feed and yardage costs and some discounts in sale price may be incurred for heavy carcass weights. In addition, Holstein steers identified as "Silage Fed" in market reports are those finished on high forage rations, and are always discounted compared to other finished Holstein steers. For these same reasons, limit-feeding Holsteins (90-70%) of ad libitum intake may not be as profitable compared to beef breeds. However, small reductions in feed intake, such as slick bunk management can improve feed efficiency without being harmful to performance or extend days on feed.

Summary

Listed here are just a few of the feeding strategies, which can improve feed efficiency in a feedlot. Several other factors including feed additives, ionophores, implants, health, stress, and environment, and others which were not covered here can impact feed efficiency. The first step for a producer is to monitor and measure their current feeding program and identify areas that can improve feed efficiency and ultimately profitability. A decision-making tool is available through UW Extension Wisconsin Beef Information Center under Resources, which aid producers in comparing different feeding programs. In the software section, a person can download the UWEX Holstein Steer Finishing Budgets spreadsheet and input their production costs to estimate returns from different feeding programs. This spreadsheet can easily be adjusted by the user, for evaluating beef breeds.

RESOURCES:

Bunk Management for Profit. R. Pritchard. http://www.beeflinks.com/BunkMngt.pdf

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Penn State University Circular 396, "Harvesting and Utilizing Forage", October 1993

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