Feed Bunk Management to Maximize Feed Intake

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Take Home Messages

- Effective communication and teamwork between the feed caller, feed truck driver, feed mill operator, nutritionist, veterinarian, and even office staff are essential for a successful feed bunk management system on a dairy operation.

Introduction

The Henry and Morrison (1928) Feeds and Feeding includes a chapter titled *Counsel in the Feedlot*. Three quotes, as cited by Pritchard (1998), serve as reminders of the importance of the human element in cattle feeding, and as discussed in this paper, feed bunk management.

> *"Many an experienced stockman can carry steers through the fattening period without getting them once 'off feed' but yet cannot well describe to others just why he is so successful."*
>
> *"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…"*
>
> *"Scouring, the bane of the stock feeder, should be carefully avoided, since a single day's laxness may cut off a week's gain. This trouble is generally brought on by over-feeding, by unwholesome feed, or by a faulty ration. Over-feeding comes from a desire of the attendant to push his cattle to better gains or from carelessness or irregularity in measuring out the feed supply. The ideal stockman has a quick*

> *discernment … which guides the hand in dealing out feed ample for the wants of all, but not a pound in excess."*

Effective feed bunk management is a key component in accomplishing the goals of any cattle feeding program (Shaver, 2002). Dairies and beef cattle feedlots are becoming more efficient by maximizing dry matter (DM) intake, which, in turn, maximizes production output. An easy way to remember the essential goals of feed bunk management are the three R's: Right ration, Right amount, and Right time.

■ Right Ration

Feed bunk management does not involve feed delivery decisions alone. It also involves ration ingredient characteristics and quality control, nutrient balancing, feed processing and mixing, and other factors related to feed presentation (Loy, 1999). Superior livestock performance begins with quality feedstuffs and a sound nutritional program. All livestock producers should establish quality standards and acceptance/rejection criteria for all feed ingredients to account for and control variation in feed composition and quality. Systematic sampling, accurate analysis, and timely ration adjustments based on nutrient density and moisture content of individual feedstuffs are fundamental to ration quality control (Kuhl, 1992). Rations should be fresh, palatable, and uniformly nutritious. Spoiled and/or moldy feed ingredients should be discarded; this helps minimize ration contamination and potential for reduced DM intake. Unfortunately, discarding of spoiled feedstuffs is not always a common practice. In a recent study at Kansas State University, growing steers were fed high-silage rations, which contained 90.0% well-preserved corn silage or 67.5% well-preserved corn silage and 22.5% spoiled corn silage (e.g., silage from the original top 3 feet in an unsealed bunker silo) (Whitlock, 1999). Steers receiving the ration with the spoiled silage had significantly lower DM intake and lower organic matter, protein, and fiber digestibilities.

Delivering the wrong ration can lead to disaster. But mistakes can and do happen. In a feedlot, an alert feed truck driver knows that when "he loads that truck with grain, it's not supposed to go to a pen of bawling calves or yearlings with sale barn tags still on 'em" (Price, 1986).

Proper feed processing and mixing are essential for optimum feed utilization. Adequate and consistent feed mixing will ensure that every bite of the ration is the same. Fine particles that separate in the bunk must be avoided, because they can contain high concentrations of minerals, feed additives, or rapidly fermentable grain particles. Ration conditioners (e.g., molasses, fat, or water); high moisture feedstuffs; and uniformity of forage particle size can help reduce fines, sorting of ingredients, and rejection of feed.

■ Right Amount

Making the feed calls (determining the amount of feed to offer) involves estimating the amount of feed a pen of cattle will consume in a 24-hour period. Therefore, the effect of a given feed intake on intake at subsequent feedings must be considered. For example, cattle might consume all of the ration offered just after an increase in the amount fed, but lose appetite and crash a day or two later (Loy, 1999). When this type of situation occurs cattle will have periods of overeating, which will result in acidosis or a sub-acute rumen acidosis condition, followed by a period of reduced feed intake while the rumen returns to a normal pH. However, this will be a continual process resulting in increased feed intake, followed by reduced feed intake, so on and so forth, but this may be difficult to observe in pens with multiple animals (Owens et al., 1998).

Intake of cattle fed rations high in forage generally is limited by ruminal fill. However, cattle fed high levels of concentrates can and do overeat. This can result in a wide variety of disturbances such as acidosis, founder, and bloat. It also can be costly because of reductions in performance from reduced average daily gain and poor feed conversion. Underfeeding cattle on high concentrate rations also can result in reduced performance (Lardy, 1999).

■ Right Time

Feed calls should be made prior to the morning feeding, with two additional observations made during consumption of the first feeding and one in the afternoon prior to feeding. Although the amount of feed offered never should be increased by more than 10%, decreasing feed offered by 10% might be warranted to ensure that cattle clean up feed remaining in the bunk before it spoils.

Most research and feedlot experiences suggest that two or more feedings a day result in better bunk and cattle management and reduce the amount of stale, wasted feed (Kuhl, 1992). This is particularly true for high moisture feeds offered during hot weather and periods of precipitation. Cattle with empty or partly empty bunks should be fed first, and the remaining cattle should be fed in an organized manner so that each feeding is at approximately the same time every day (Lake, 1981). The time allotted to dairy cattle for the consumption of their ration is as important as the amount of feed offered. When feeding time is limited to less than 8 hours per day, milk production can be reduced from 5 to 7% in mid-lactation cows, and to an even greater extent in high producing cows, which are at or near peak lactation (NRC, 2001).

All ration changes should be made at the afternoon feeding to eliminate the possibility of feeding hungry cattle a new, higher energy ration. This also decreases the incidence of digestive upset and sub-acute rumen acidosis.

▪ Feed Bunk Management Variables

Many variables can affect feed intake, including animal factors, weather, ration ingredients and characteristics, water supply, feed bunk design, and feeding management systems. Proper bunk management depends on the feed caller understanding how these variables affect DM intake and recognizing problems as they occur. Dry matter intake is primarily affected by milk yield (45% of variation); however, ration and feeding management (22% of variation), body weight (17% of variation), climate (10% of variation), and body condition score (6% of variation) all affect fluctuations in DM intake in lactating dairy cattle (Roseler et al., 1997).

Animal

Several animal-related factors influence expected DM intake, including breed type, age, body weight, sex, stage of lactation, stage of pregnancy, and general health. These factors need to be considered when making feed calls. Dairy breeds can be more temperamental eaters than beef breeds, and they typically consume 8 to 10% more feed (Kuhl, 1992).

Researchers at Michigan State University (as cited by Miller, 1998a) found that first-calf heifers ate more meals, spent less time at each meal, and ate less at each meal than older cows. Thus, in large herds, separating first-calf heifers from older cows might reduce competition and improve performance (Ballantine, 1998; Schoonmaker, 1999a,b).

Body weight and sex also affect DM intake. Typically, calves consume 8 to 12% less than yearlings of the same weight, although younger calves eat a higher percentage of their body weight. Heifers often eat 4 to 5% less than steers of a similar weight (Kuhl, 1992).

As milk production goes up, DM intake increases (Miller, 1998a). During pregnancy, dairy cattle steadily decrease DM intake. At the start of the dry period, intake falls sharply and remains low until a week to a few days before parturition.

Making feed calls for cattle fed transition rations can be especially challenging but very important in getting feedlot cattle to ad libitum intake. Newly weaned and stressed calves will increase their DM intake from 0.5% of body weight to about 3.5% in 28 days (Hutcheson, 1981, as cited by Kuhl,1988).

Health also will affect feed intake, and, thus, affect feed bunk management. For example, de-worming calves increases feed intake by about 3% (Davis, 1979, as cited by Kuhl, 1988). Conversely, bunk management observations can aid in detecting large-scale health problems.

Another factor is cattle appetite. Hungry cattle are more aggressive at the feed bunk, which leads to over consumption and related digestive problems in aggressive cattle, whereas timid cattle remain underfed (Lardy, 1999).

Weather

Seasonal, long-term weather patterns as well as day-to-day weather changes can influence cattle performance and feed intake (Fitzgerald, 1984; Pritchard, 1992). Feed callers need to take into account the previous and predicted following days' weather when making feeding decisions. By anticipating and reacting to changes in temperature, humidity, wind velocity, barometric pressure, and precipitation, the feed caller can better predict intake, and feed wastage and bunk cleaning can be minimized.

Cattle consume the majority of their feed during the comfortable period of the day. In hot weather, cattle eat primarily during the late evening, night, and early morning. Therefore, 60% of the ration should be fed at the afternoon feeding to reduce feed spoilage. In cold weather, most eating occurs from mid-morning to late afternoon (Lake, 1981), so the largest amount of feed offered should be at the morning feeding.

Day-to-day weather changes such as rain can influence palatability of a ration, especially in warm weather. Wet feed should be cleaned out of the bunks and replaced with a fresh mix of the ration to reduce intake fluctuations. Rain also can affect feed consumption because of the secondary effects of muddy lots. When cattle must struggle to walk to the feed bunk, maintenance energy requirement increases and frequency of eating times decreases.

Ration Ingredients and Characteristics

As previously mentioned, high quality feed must be presented to cattle in a consistent and uniform manner. Fiber length is critical for healthy rumen function. A Penn State Particle Separator is an easy way to determine length of cut and mixing time, if a total mixed ration (TMR) is to be used. When using the new four-box Penn State Particle Separator, approximately 15% of the ration should remain in the top box, which represents coarse particles; 40 to 50%, should remain in the second box, which represents particles between 0.3 to 0.75 inches. Total mixed rations should contain approximately 50% DM, as rations that are below 50% DM can limit DM intake (Miller, 1998a).

To minimize TMR variability it is important to minimize ingredient variation. Develop an easy way to adapt the ration to whatever changes are required. Make a premix of dry, non-forage ingredients, set a mixing procedure (e.g., proper mixing time) and sequence for adding ingredients, and monitor the quality of the ration after mixing (Buckmaster cited by Franck, 1999).

Efforts to increase milk production through use of highly fermentable starches, similar to those found in steam-flaked grain or ensiled, high moisture grain, can provide increased energy density but can also decrease DM intake due to digestive upsets described previously (Knowlton et al., 1998 and Moore et al., 1992). Monitoring cattle in the pen can be an effective way to determine the impact of feed bunk management, the goal should be to have approximately 50% of the animals lying down in stalls to be chewing their cud, which indicates efficient rumination and a healthy digestive tract.

Keeping fresh feed in the feed bunk is also a good management practice. Old feed remaining in the feed bunk can shorten bunk life of new feed and reduce DM intake (Ballantine, 1998). Bunk management also varies with ingredients and types of rations being fed. Some ingredients have less bunk stability than others, e.g., rations containing high-moisture ensiled grains deteriorate rapidly (Lake, 1981).

Water Supply

Many producers overlook the importance of water availability as it relates to bunk management, including the amount of water, space provided, and the location of water sources. Problems that limit water intake also can limit feed intake, and this, in turn, can reduce milk production and overall cow performance (Ballantine, 1998; Miller, 1998b). Poor water quality or lack of water can cause cattle to go off feed quickly. Feed callers need to recognize this problem before making any drastic changes in the amount of feed offered.

In free-stall barns, 3 inches of linear space per cow and one watering space (or 2 feet of tank perimeter) for each 15 to 20 cows are recommended (Brett, 1999). A water depth of 6 to 8 inches is suggested to help keep the water fresh and easier to clean, because less debris accumulates (Miller, 1998a).

As temperature and humidity go up, more water is required. During months of hot weather, water supply becomes an important issue. Cows drink most of their daily water requirements around milking time. They should have access to water in holding pens during milking or right after (Ballantine, 1998). Adding water tanks for the summer can help in both feedlot and dairy operations (Miller, 1998a).

Feed Bunk Design

Good feed bunk design is also essential to optimizing DM intake. Dairy cows should have 60 to 75 cm of bunk space each to allow all of them to eat at the same time. Some designs such as 3-row and 6-row free stall barns limit the space per cow. The feed bunk or feed pad should be 10 to 15 cm higher than the alley where cows are standing. This gives the cows a natural grazing position when eating (Miller, 1998a,b). Cows consuming feed at ground level waste less feed, and this position also helps cows to produce more saliva and improves the buffering capacity in the rumen (Ballantine, 1998).

In addition, the condition of the feeding surface can affect DM intake. Feed bunks must have smooth surfaces. Surfaces without grooves or holes that can trap feed are easier to clean and help reduce buildup of waste feed, mold growth, and odor (Ballantine, 1998; Miller, 1998). Avoiding muddy conditions and manure buildup on feed bunk aprons is also important (Lake, 1981). These conditions can decrease palatability of the ration as well as increase the transmission of disease.

Feeding Management and Systems

Because cattle are animals of habit, they like routine. Once a schedule is developed, stick to it. If a change is needed, cows must have time to adjust. Monitor DM intake to see if the change improved consumption or did not affect it at all. Make sure that the feed left over is similar to the TMR or the feed that is being fed. Feed as many times as possible (Miller, 1998a, b). It is important to keep feed available any time the cattle are willing to eat, which could be 20 to 22 hours a day (Ballantine, 1998). However, in situations with rising feed costs and reduced milk values, unlimited access to feed may not be advisable. Targeting a 5% feed refusal rate in efforts not to limit milk production and provide animals with a constant feed supply, may result in reduced profit and increased cost due to feed removal, nutrient disposal, and wasted feed ingredients. Assuming typical DM intakes for dairy cattle, a 1,000 head dairy will generate over one ton of feed waste per day when targeting a 5% refusal rate. From a nutrient stand point, the nutrients of concern for dairies in regards to their waste management plans are no different when excess nitrogen, phosphorus, or other mineral is generated by manure, urine, or feed ingredients. Research results with dairy cattle for the optimal number of feedings vary depending on season of year, bunk life of the ration, types of feed ingredients, and milk yield (Miller, 1998a).

Because these variables that affect DM intake vary from day-to-day and month-to-month, feed bunk management has been forced to go through an evolution. Systematic approaches to a highly subjective decision can reduce large fluxes in a cattle feeding program.

One feed bunk management system has been developed and implemented by South Dakota State University. The bunk scoring sheet takes into account the many variables that have been discussed previously and provides additional information that might help when making a feeding decision: 1) pen number, 2) lot number, 3) head count, 4) in weight, 5) current weight, 6) days on feed, 7) days on ration, 8) indication of slick bunks, 9) indication of when bunk was last cleaned, and 10) amount of feed fed in the last 5 to 7 days.

South Dakota State University also developed a specific 4-point feed bunk scoring system (Table 1). By providing a detailed description of the feed remaining in the bunk, this system decreases variability of feed calls (Pritchard, as cited by Loy, 1999). These records are used at each feed call and at least 4 days of records can be kept to determine cattle response to a feed change. Keeping records for the complete duration of days on feed will help to determine feed conversions, seasonal variability, production costs, and to evaluate feed callers.

Table 1. South Dakota State University 4-Point Feed bunk Scoring System.

Score	Description
0	No feed remaining in the feed bunk.
½	Only scattered feed remaining from the previous feeding. Most of bottom of the feed bunk or feed pad is exposed.
1	Thin, uniform layer of feed remaining across the bottom of the feed bunk. Typically, about ½-inch or less in depth.
2	25 to 50% feed remaining from the previous feeding.
3	The ‘crown’ of previous feed is thoroughly disturbed and more than 50% of the feed remains.
4	The ‘crown’ of previous feed is still noticeable. Feed is virtually untouched.

Another system for scoring feed bunks has been developed by Penn State researchers (cited by Behling, 2002). It is a very similar system to the one described by Pritchard, which scores feed bunks from 0 to 5. A feed bunk with a score of 0 would have no feed remaining from the previous feeding, a score of 1 would have less than 5% feed remaining, a score of 2 would have about 10% feed remaining, a score of 3 would have about 25% feed remaining (and less than a 3-inch depth of feed), a score of 4 would have about 50% feed remaining (and more than a 3-inch depth of feed), and a score of 5 would indicate that the feed was untouched.

Whichever system or variation of these systems that is used by a dairy operation, feed calls are typically made to provide approximately 5% feed refusal daily. Through an individual management plan and prioritizing feed bunk management, decreasing the amount of feed refusal to 3% or less should decrease overall feed costs without impacting milk production and cow health.

Although the variables discussed above constitute the basis of feed bunk management, an effective system depends on teamwork between the feed caller, feed truck driver, feed mill operator, nutritionist, veterinarian, and the office staff. Scientific guidelines can decrease some of the variability, but unless they are used in cooperation with good personnel management efficiency, a dairy operation's goals will not be met.

■ Feeding Surface-Spoiled Silage: The Consequences

Sealing with a polyethylene sheet weighted with tires is not 100 percent effective. Aerobic spoilage occurs to some degree in virtually all sealed silos. And the discarding of surface spoiled is not always a common practice on the farm. But results of a recent study at Kansas State University (Tables 2 and 3) showed that feeding surface spoilage had a significant negative impact on the nutritive value of a whole-plant corn silage-based ration.

The original top 0.9 meters of corn silage in a bunker silo was allowed to spoil, and it was fed to steers fitted with ruminal cannulas. The four experimental rations contained 90% silage and 10% supplement (on a DM basis), and the proportions of silage in the rations were: A) 100% normal, B) 75% normal:25% spoiled; C) 50% normal:50% spoiled, and D) 25% normal:75% spoiled.

The proportion of the original top 45-cm and bottom 45-cm spoilage layers in the composited surface-spoiled silage was 24 and 76%, respectively. The original top 45-cm layer was visually quite typical of an unsealed layer of silage that had undergone several months of exposure to air and rainfall. It had a foul odor, was black in color, and had a slimy, "mud-like" texture. Its extensive deterioration during storage also was reflected in very high pH, ash, and fiber values. The original bottom 45-cm layer had an aroma and appearance usually associated with wet, high-acid corn silages, i.e., a bright yellow color, a low pH, and a very strong acetic acid smell.

The addition of surface-spoiled silage had large negative associative effects on DM intake and OM, NDF, and ADF digestibilities. The first 25% increment of spoilage had the greatest negative impact. When the rumen contents were evacuated, the spoiled silage had also partially or totally destroyed the integrity of the "forage mat" in the rumen. The results clearly showed that surface spoilage reduced the nutritive value of corn silage-based rations more than was expected.

Table 2. pH and chemical composition of the corn silages fed in metabolism study.

Silages	pH	DM	OM	Starch	CP	NDF	ADF
		%	---------------- % of the DM ----------------				
Normal	3.90	38.0	94.7	22.3	6.9	42.6	23.4
Surface-spoiled, composite of the original top 90 cm	4.79	26.4	90.9	24.3	9.9	48.9	31.0
Surface-spoilage layers							
Original 0-45 cm (slime layer)	8.22	19.1	80.0	2.7	17.7	57.6	48.3
Original 46-90 cm (acidic layer)	3.67	27.6	94.3	26.1	6.7	48.5	25.5

Table 3. Effect of surface-spoiled silage on DM intake and nutrient digestibilities.

Item	Ration			
	A	B	C	D
DM intake, kg/day	7.95[a]	7.34[b]	6.94[b,c]	6.66[c]
	------------------------- Digestibility, % -------------------------			
OM	75.6[a]	70.6[b]	69.0[b]	67.8[b]
CP	74.6[a]	70.5[b]	68.0[b]	62.8[c]
NDF	63.2[a]	56.0[b]	52.5[b]	52.3[b]
ADF	56.1[a]	46.2[b]	41.3[b]	40.5[b]

[a,b,c] Means within a row with no common superscript differ (P<.05).

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