

# Controlling and Managing Feed Variation – A Farm Perspective

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## Introduction

Dairy managers and cows cause feeding changes on the farm. Some changes are intentional (such as reformulation of rations) while other *just happen* (such as feed sorting). The skilled manager, feed consultant, and veterinarian are continually evaluating and *reading* cows. On-farm strategies and records can be used to monitor changes, evaluate responses, and determine economic comparisons of feeding program variation. Each person should develop an approach and checklists to implement on the farm.

## Sources of Variation

Previous speakers have identified the variation in feedstuffs fed to dairy cattle. Dairy managers and feed consultants will need to manage and address these concerns and adjust rations. Once the feed ingredients have been selected and rations adjusted for variation, the following sources of variation should be considered: variation in adding the amount of ingredients, variation in dry matter content of wet feed ingredients, and variation introduced by cow behavior and eating characteristics.

### Variation in the amount of feed ingredients

Adding each feed ingredient allows for both overfeeding and underfeeding of a feed ingredient in the final **TMR** or total mixed ration. The individual and dairy manager can minimize this variation using the following techniques:

- Store free-flowing feed ingredients in vertical storage and load using motor driven augers than can be quickly stopped once the desired amount of feed has been added.
- Contract with a commercial company to premix several ingredients (such as soybean meal, distillers grains, cottonseed, minerals/vitamin premix, and additives) to insure a more uniform feed that can be

added in one larger quantity to minimize errors in the amount of feed added.

- Blend an ingredient with other feeds to achieve an inclusion rate of two or more pounds per cow to enhance the ability of TMR mixers to mix feed properly and reduce errors of addition.

### Variation in feed dry matter content

Wet feed ingredients (such as corn silage, haylage, wet brewers grain, and other wet ingredients) can vary on farms based on the feed source. Silages can also vary due to field and harvest variation, fermentation losses, storage losses (seepage), and additional precipitation (snow or rain). A plan should be developed to minimize and measure this variation. One plan could include weekly monitoring of wet feeds or when a precipitation event occurs. Systems to monitor dry matter variation can be simple to complex depending on the personnel involved, turn around time, and time available.

- Food dehydrator (inexpensive to purchase, no monitoring, and takes one day for results)
- Koster tester (more expensive to purchase, requires several weighing events, and minimal monitoring)
- Microwave oven (used units can be inexpensive, fast, and must be monitored)
- Electronic moisture tester (more expensive initially, quick, and more variable result)
- Commercial lab (accurate, no investment, and longer time to get results)

### Variation in feed particles

Measuring forage particle size using the Penn State particle boxes continues to be an on-farm method to objectively evaluate forage and TMR particle length. Compare the weight in each box to the guidelines in Table 1. Recent field observations indicate if the top screen for TMR is over 15 percent, cows may sort the ration. Feed particles in the middle box may be more important than the top box only.

The Penn State box can also be used to evaluate weigh back or orts to determine if feed sorting has occurred. One guideline is the percent of feed in each box in the weight back should be within five percentage points of the original TMR.

Illinois workers use the following set of sieves to measure and monitor dry corn particle size.

- Top screen (number 4 and 4750 microns) captures whole and large particles
- Second screen (number 8 and 2360 microns) represents cracked corn
- Third screen (number 16 or 1180 microns) represents *cow* corn particles
- Fourth screen (number 30 or 600 microns) represents *pig* corn particles
- The pan which represents powder or feed grade starch

No dry corn should appear on the number 4 screen (passes undigested), less than 10 percent on the number 8 screen (some loss in the manure), 25 to 35 percent on the number 16 screen (slow released starch in the rumen and small intestine digestion), 50 to 60 percent on the number 30 screen (finely ground feed for rumen fermentation) and less than 15 percent in the pan (rapidly available starch for the rumen microbes). If the ration contains higher levels of wet haylage, lower amounts of corn, and byproduct feeds; the dry corn particle size could be reduced. Reducing corn particle size will increase the risk of rumen acidosis. Brass U.S. Standard sieves can be purchased from Fisher Scientific (800-766-7000) or Seedboro Equipment Company (312-738-3700). Prices will vary from \$200 to \$260 per set of five. Another approach to measure finely ground corn is to use a flour sifter (similar to a number 14 or 16 screen) to estimate particle size. Properly processed corn will have one third remaining in the flour sifter (two thirds will pass through the 1/14 inch opening or 1/16 inch opening).

### Variation in mixing the feeds on the farm

Several sources of mixing variation on the farm include the TMR mixer, management of the mixer, and the skill of the personnel using the equipment. The following factors can be used to minimize feed mixing variation.

- Add feeds in the proper order to insure proper mixing based on the manufacturer's recommendations.
- Limit the mixing time to avoid over and under mixing (typically 3 to 7 minutes).
- Monitor the accuracy when adding ingredients (actual pounds of added feed and if feeders return excessive feed or retrieve more feed if the amount is short).
- Consider a premixed grain mixture to reduce the number of feeds and errors in addition.
- Move to vertical storage of feed ingredients that flow and can be added to the TMR more accurately.
- Evaluate mixing variation of the TMR delivered to the feed bunk using the Penn State Particle Box by measuring variation at six different areas in the feed bunk (should be + / - 5 percent in each box) or look for *marker* feeds (fuzzy cottonseed, roasted soybeans, or pellets).

Several commercially available computerized feed management software systems are available including: EZfeed, [www.dhiprovo.com](http://www.dhiprovo.com); Feed Supervisor, [www.feedsupervisor.com](http://www.feedsupervisor.com); Feed Watch, [www.vas.com](http://www.vas.com), and TMR Tracker, [www.digi-star.com](http://www.digi-star.com). These systems allow collecting of actual feed amounts added, tracking inventory, evaluating feed shrinkage, and updating of dry matter content of wet feeds to correct for dry matter changes.

### Variation due to cow sorting

On all farms, four rations occur: (1) the calculated ration from the computer, (2) the ration

**Table 1.** Penn State particle size box guidelines expressed as the percent in each box on an as fed basis (adapted from Hutjens, 2001).

	Corn Silage	Haylage	TMR
	---- % on each screen (wet basis)----		
Top box	5 to 15	> 40	10 to 15
2 <sup>nd</sup> box	> 50	> 40	40 to 50
3 <sup>rd</sup> box	< 30	< 20	< 30
4 <sup>th</sup> box (pan)	< 5	< 5	< 15

mixed by the feeder, (3) the ration consumed by the cow, and (4) the ration digested and the nutrients absorbed by the cow. Successful managers attempt to make these four potentially different rations perform as if the same ration. Feed sorting is a major problem as cows select feed ingredients based on quality, particle size, and palatability. Wisconsin workers measured feed selection on a high producing dairy herd (over 24,000 of milk per cow) fed TMR once a day. Feed sorting was evaluated over six-hour time intervals. Table 2 illustrates the sorting that occurred in the first 12 hours, resulting in limited amounts of long forage particles consumed. To minimize ration sorting, the following guidelines can be effective.

- Reduce forage particle size to less than 2 inches in length.
- Increase forage quality to improve intake and palatability.
- Add 5 to 10 pounds of water per cow.
- Select a wet feed ingredient such as wet brewers grains, wet corn distillers grains, corn distillers solubles, and/or molasses/whey blends.
- Feed TMR more frequently each day.
- Push up and mix feed several times a day.
- Remove *true* weigh backs.
- Process corn silage to reduce corn cob size.

#### Variation in dry matter intake and orts

Evaluating dry matter intake and feed refusal variation can be another approach to monitor feed related variation. If a feeding change is implemented or feed variation is reduced (for example changing from one to two feedings a day) and dry matter intake increases by two pounds or more, the change or reduction in variation is significant. Monitor feed

weigh backs targeting 2 to 4 percent of the total amount fed to a group of cows. If dry matter changes by two pounds per cow or weigh back changes by one pound per cow, check for the cause of variation.

### Measuring Cow Response to Feed Variation

*Listening to your cows* is an approach to monitor variation on the farm. The final analysis is if cows are performing at an optimal level based on the sources of variation on the farm. Several measurements can be used, but each person must determine acceptable deviations from normal values before making changes and reducing variation.

*Milk production records* can be one approach to determine if feed variation is causing production or health problems. Monitoring pen or group averages in larger herds would be valuable data on a daily basis by using milk flow meters to monitor daily milk yield adjusted for the number of cows, days in milk, and age of the cows. Management level milk (MLM) or 150-day milk converts milk production to a common base: 150<sup>th</sup> day of milk production, same lactation number (usually second lactation), and the same milk components (fat and protein). MLM changes due to a feeding variation are adjusted for days in milk, age of cows, and component changes. The dairy manager can also evaluate if the feeding change or reduced variation had an impact. As a guideline, a shift of two pounds in MLM due to the feeding change may be significant.

*Milk components and patterns* can reflect changes in rumen pH, nutrients delivered in the ration dry matter, dry matter intake, and body weight loss. Table 3 lists normal breed component values.

**Table 2.** TMR particle size distribution at six-hour intervals after feeding (fed once a day) using the Penn State Particle Size Box analysis (Martin, 2000).

Box (% as is basis)	----- Time after feeding (hours) -----				
	0	6	12	18	23
Top	9	14	21	28	59
Middle	47	42	42	39	27
Bottom	44	44	37	33	14

Milk fat/milk protein test inversions can be defined as cows having milk fat tests that are 0.2 milk fat percentage units or more lower compared to milk protein test percentage units. For example, a Holstein cow with a 3.0 percent milk protein test and 2.8 percent milk fat test or lower would be inverted using true protein test. The following guidelines can be used to determine if a feeding practice or variation has led to a milk fat test inversion.

- Over 10 percent of the cows in the herd have milk fat inversions
- Cows one full point below the breed average milk fat percent

*Rumen pH* can be measured by testing 12 or more cows four hours after eating using a rumen tape or rumenocentesis (a needle is inserted into the lower left side of the cow and a small sample of rumen fluid extracted). If over 25 percent of the cows have rumen pH values below 5.5, sub-acute rumen acidosis (**SARA**) may be occurring.

*Serum beta hydroxybutyrate acid (BHBA)* is measured by taking a blood serum sample from cows 5 to 50 days after calving at 4 to 5 hours after eating a meal. Serum level over 14.4 mg per deciliter in 10 percent or more of the sampled cows indicated sub-clinical ketosis (values over 26 are ketotic cows).

*Plasma non-esterified fatty acids (NEFA)* reflect if cows are mobilizing body weight to meet energy shortages. Blood is taken from cows 2 day to 14 days before calving. Test only the blood from those cows that actually calve in the next 2 to 4 days (cows do not calve on time and blood samples can not be taken if the cow has calved early). Sample cows prior to the main feeding. If greater than 10 percent of the 12 cows sampled are over 0.400 milliequivalent per liter (400 meq/ml), a potential

energy deficiency may be occurring in the herd leading to metabolic disorders.

*Urine pH* from cows receiving anionic products to prevent milk fever and minimize hypocalcemia (low blood calcium) should average 6.0 to 6.5 for Holstein cows. Collect urine samples after cows were fed anionic products for a minimum of 2 to 3 days. Sample a minimum of eight cows at four to eight hours after the cows have consumed feed (especially if dry cows are fed once a day).

*Milk urea nitrogen (MUN)* and blood urea nitrogen (**BUN**) reflect if an optimal balance of protein (especially degradable and soluble protein fractions) and fermentable carbohydrate occurs. Sample 8 to 10 cows per group to determine if the average is between 10 and 14 milligrams per deciliter for MUN. For BUN analysis, sample 2 to 4 hours after a major meal has been consumed. Looking at groups of 8 to 10 cows (by lactation, days in milk, feed group, or level of milk production) to evaluate MUN values.

*Manure evaluation* can be useful guides when monitoring feed changes and evaluating variation. Fresh, undisturbed piles of feces or droppings may provide valuable clues on the status of the cow. Three aspects of manure evaluation can be considered.

- **Washing manure.** Washing manure through a screen (8 or 16 squares to the inch) allows the dairy manager to quickly find or *see* if feed processing and digestion is optimal. Take a cup of fresh manure (about 400 grams) and wash it with a stream of warm water through the screen removing the digested material. Look for the following remaining feed particles.

**Table 3.** Normal milk fat and milk protein relationship for various breeds of dairy cattle in 2002 (adapted from Hoard's Dairyman, 2003).

Breed	Milk Fat (%)	True Protein (%)	Ratio (% protein / % fat)
Ayrshire	3.84	3.12	0.81
Brown Swiss	3.97	3.25	0.82
Guernsey	4.47	3.31	0.74
Holstein	3.66	2.98	0.81
Jersey	4.56	3.55	0.78

Finding pieces of barley or corn grain with white starch remaining indicate that starch remains. If the seed and starch pieces are hard, additional grinding or processing may be needed to expose the starch to rumen microbial fermentation or lower gut enzymatic digestion. Corn kernels from corn silage reflect that the seed was too hard for digestion and plant processing did not occur. Mature and dry corn silage can cause this observation. Whole cottonseeds or soybean splits (half of a soybean seed) that appear in the washed manure reflect a loss of feed nutrients. Cottonseeds are not caught in the rumen mat and ruminated to be chewed. Roasted soybean seeds can be hard and must be processed finer. Wisconsin workers suggest breaking soybeans into fourths or eighths. Forage particles over 0.5 inch may reflect a lack of long forage particles to maintain the rumen mat and adequate cud chewing. A higher rate of passage reduces the time needed in the rumen to digest the fiber properly.

- **Scoring manure.** Michigan workers developed a scoring system to evaluate fresh manure. Consistency is dependent on water and fiber content of the manure, type of feed, and passage rate. A scale of 1 to 5 is used with a score of 3 optimal.
- **Manure color.** The color of manure is influenced by feed, amount of bile, and passage rate. Manure from cows on pasture is dark green, while hay-based rations are brown. Manure from high grain-based diets is more gray-like. Slower rates of passage cause the color to darken and become more ball-shaped with a shine on the surface due to mucus coating. Score 1 may be more pale due to more water and less bile content. Hemorrhage in the small intestine causes black and tar-

like manure, while bleeding in the rectum results in red to brown discoloration or streaks of red.

*Changing nutrient level* can be another approach to evaluate if cows will respond. If added protein or protected amino acids are fed, a production response can be expected in one week. Monitor milk protein test along with milk yield. Adding fat or oil can increase milk production or milk fat test. Increasing minerals will not increase milk production, but can impact reproduction and/or health. Allow six months to a year before evaluating mineral responses. Additive responses are varied in measurable responses and expected timeline.

*Feed efficiency* can be calculated by expressing the pounds of milk produced per pound of dry matter. Factors affecting feed efficiency include number of groups on a farm, days in milk, lactation number, body condition score shifts, growth requirements, forage quality, milk components, and environmental stress. Feed efficiency values below 1.3 are a concern. Herds fed as a one group TMR vary from 1.4 to 1.5, early lactation first lactation cow groups vary from 1.5 to 1.6, and early lactation mature cows vary from 1.6 to 1.7. Other nutrient efficiencies such as nitrogen retention as milk protein or energy efficiency as milk and/or tissue may be calculated in the future.

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