Tools For Diagnosing Nutritional Problems In Dairy Herds

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Tools Discussed

1. Examine Milk Records
2. Observe cows and feeding facilities
3. Remeasure DMI
4. Forage Particle Size
5. Milk Urea Nitrogen (MUN)
6. Body Condition Scoring
7. Urine pH of Close-up Dry Cows

Several diagnostic tools are available to help nutritionists, veterinarians and producers discover the cause of a suspected nutritional problem and, more importantly, to help fine-tune rations for the most profitable milk production response. These tools can be used together to pinpoint a particular nutritional and/or management problem which may be the cause of suboptimal milk production, low reproductive efficiency, or metabolic diseases. Often times, it is stated that three different rations are fed to dairy cows. These rations include those formulated on paper by a nutritionist, the ration the farmer mixes and feeds to his/her cows, and, finally, the ration the cow actually consumes. The diagnostic tools outlined here can help pinpoint areas in ration formulation and feed delivery which may be causing a nutritional imbalance.

Examine Milk Records

Taking time to examine both the production and reproductive records can provide several leads as to when this problem started and may provide some answers as to the cause. The total amount of milk in the bulk tank should be the first area evaluated to determine how well a feeding and management program is working. Sound feeding and management programs result in little variation in milk weights between pickups. If milk production decreases by more than 3 to 5% from one pickup to the next, changes in the amount and quality of forages fed should be examined closely.

Although the amount of milk in the bulk tank is important to the cash flow of the operation, it does not give the total picture as to how well a feeding program is working. Changes in the number of cows being milked and/or numbers of cows in each stage of lactation can greatly distort changes in milk production per cow. To accurately evaluate and fine-tune a feeding program, the amount of milk produced by each cow should be recorded monthly. These data can be summarized through a DHIA program or farmers can record and summarize these data themselves using commercially-available computer programs.

For herds enrolled on DHIA, the herd summary sheet (DHI-202) provides a summarization of not only the milk production for all cows but also provides a summary to assess the reproductive and mastitis programs in place in the herd. When trying to diagnose the cause of low milk production, mastitis and reproductive performance needs to be examined. High cell counts and long calving intervals can decrease milk production. From a nutritional standpoint, two major areas to evaluate on a farmer's DHIA herd summary sheet include:

❏ Standardized 150-day milk production is an estimate of what the average cow would have produced this month if she was 150-days in milk. Each month, DHIA recalculates this value to reflect the current month's production data. This calculated value removes the effects of stage of lactation and allows a comparison between months. If this value decreases by more than 2 to 4 pounds of milk, changes made in the feeding and management for this month need to be re-examined.

❏ Average peak milk production for first, second, and mature cows is also summarized. The higher cows peak in milk production, the more milk they give over a lactation. For every pound higher cows peak in milk production, they normally will produce 200 lbs more milk over that lactation. Often times, we see that first and/or second lactation cows are not peaking in production. First-calf heifers may have limited bunk space and consequently, do not compete with the mature cows or the heifer rearing program needs to be fine-tuned to ensure proper heifer growth. Second lactation cows often experience "sophomore slump" when they were not fed enough energy and protein during the first lactation to regain the body condition lost during early lactation.

(For more information, see University of Kentucky Factsheet ASC-137: “Accomplishing a Sound Dairy Nutritional Program".)

Observe Cows and Feeding Facilities

Excellent observational skills are critical in diagnosing the cause of many nutritional problems. Taking time to observe cows eating and resting can provide invaluable clues as to the subtle problems in the feeding and management scheme. Cow comfort is necessary for optimum milk production. Free stalls need to be long enough, provide a comfortable surface for the cow to lie on, and have enough lunge space for the cow to use as she is getting up in the stall. Approximately, 40% of the cows resting should be chewing their cuds.

Fresh feed needs to be readily accessible to cows 20 hours a day for maximum dry matter intake. A simple glance into the feedbunk to see if feed is available can go a long way in explaining why cows are not milking as well as expected. Insufficient bunk space for silages or hay often limits intake especially in early lactation cows and more timid first-calf heifers. (Recommendation is to have 24 to 30 inches of bunk space per cow when all cows are fed forage twice daily.). Often times, too few round bale feeders are provided for not only milking cows but also dry cows and heifers. For the milking herd, one round bale feeder per 15 cows is recommended when hay is fed free-choice. Feed bunks and grain troughs in the parlor need to be cleaned out on a regular basis to prevent moldy and poor quality feed being presented to the milking herd. A clean , cool source of water needs to be within 50 feet of the feedbunk.

Remeasure Dry Matter Intake

The amount of dry matter a cow consumes determines the amount of nutrients she receives and ultimately the amount of milk she will produce. Too often, the amount of feed consumed by the milking herd is less than recommended in the original ration balanced by the nutritionist or the quality and/or type of forage being fed has changed. A portable scale to measure the average intake of silages, square bales of hay, and grain is invaluable in solving many nutritional-based problems.

The dry matter content of wet feeds, such as silages and wet by-products, can greatly influence the amount of dry matter actually being consumed. The dry matter content of silages stored in a trench, bunker, or open upright silos can change dramatically during periods of heavy rain. Also, the dry matter of silages can change when a different cutting or harvest date is fed. The dry matter content of these feeds can be determined using a Koster tester or microwave oven.

Forage Particle Size

Cattle require roughages in their diets to maintain normal rumen function, to allow for efficient fiber digestion, and to maximize energy intake from economical feedstuffs. Roughages are supplied by a combination of forages and/or roughage byproducts. These products stimulate the cow to chew and ruminate. This, in turn, stimulates saliva production which buffers the rumen contents allowing for efficient microbial fermentation. Maintaining the proper particle size in forages is critical in stimulating the cow to chew her cud. Cows which do not receive adequate amounts of effective fiber to stimulate cud chewing often times have low dry matter intakes, reduced butterfat tests, high incidence of displaced abomasum, and more cases of laminitis and other foot problems.

Table 1. Recommended particle distribution for the Penn State Particle Separator

Feedstuff	Top Screen	Middle Screen	Bottom Screen
Corn Silage	2-4% (long hay fed) 5-10% (only forage)	40 to 50%	40 to 50%
Hay Silage	8 to 12% bottom unloader 10 to 15% top unloader	30 to 40%	30 to 50%
TMR	6 to 10% minimum	40 to 50%	40 to 60%

Source: Heinrichs 1996 Hoard's Dairyman

The Penn State Forage Particle Separator can be used to quantify the distribution of particle size within a forage and, more importantly, in a total mixed ration. The separator consists of three boxes stacked on top of one another. The top screen retains particles which are 3/4 inch or greater with the middle screen retaining particles between 5/16 to 3/4 inch. The bottom screen has a solid bottom and it retains particles under 5/16 inch. Table 1 shows the recommended particle distribution for corn silage, hay crop silage, and total mixed rations. Corn silage should be chopped to 3/8 to ½ inch theoretical length so that 15 to 20% of the TMR has particles greater than 1.5 inches long. Mixing of TMR mixer wagons for more than 5 minutes can result in very short particle length with most of the effective fiber in the diet being pulverized by the augers. This problem can result in displaced abomasum, feet problems such as laminitis, low butterfat test, low dry matter intake, and cows going off-feed. A large variation in particle length of chopped forages occurs between farms. Table 2 shows the distribution of particle size of 5210 samples of forages and total mixed ration submitted to a northeast forage laboratory. Thus, the particle size of silages must be considered when balancing rations for individual farms.

Table 2. Average distribution of particle size for various forages and total mixed rations processed over a 4 month period by a Northeast forage laboratory.

Forage	Number of Samples	Top Screen		Middle Screen		Bottom Screen	
		Mean	SD	Mean	SD	Mean	SD
Grass	464	17.6	12.2	41.5	12.9	40.9	16.0
Mixed, Mostly Grass	280	19.4	13.8	37.2	11.0	43.4	14.9
Mixed	387	17.6	11.9	37.3	9.6	45.2	13.4
Mixed Mostly Legume	926	16.9	12.1	36.5	9.7	46.0	14.4
Legume	1252	16.6	10.9	39.7	9.4	43.8	12.4
Corn Silage	2134	6.6	5.1	51.1	11.6	42.3	13.6
TMR	367	6.1	4.5	35.5	10.1	58.4	11.5

Source: Lammers and others, 1996, J Dairy Science Abstracts

Milk Urea Nitrogen

Milk urea nitrogen (MUN) is one way to access the protein status of dairy cows. When cows consume a diet, the microbes within the rumen degrade the protein to ammonia. The microbes, in turn, use ammonia and fermentable carbohydrates to make amino acids and microbial protein which then are degraded by the cow in her small intestine. Excess ammonia is absorbed across the rumen wall and passes to the liver via the portal vein where it is converted to urea. Urea can either be recycled back to the rumen by the saliva or be excreted in the urine. Cows have to expend 2 Mcal or more of energy to excrete the excess urea through the urine. Thus, excretion of excess urea is an energy requiring process. Excess concentrations of urea in the blood are believed to have detrimental effects on milk production, reproductive efficiency, embryo survivability, and immune function. In addition, excess urea excreted in the urine has to be dealt with from an environmental standpoint.

Sampling: Careful collection of the composite, individual cow milk samples is necessary to ensure that the urea concentration in the milk sample is not reduced by microbial activity. Milk samples should be preserved with a fermentation inhibitor or refrigerated until analyzed. MUN values have been shown to decrease by 50% in milk samples kept at room temperature for 48 hours. Samples representing the entire milking which can be collected from milk meters or weigh jars are preferred. When this is not possible, Gustafsson and Palmquist have suggested that milk samples be collected at the end of milking rather than at the beginning. Samples should be collected from at least 10 cows within the herd or production group.

Several tests are used to measure MUN. Several DHIA labs have the capabilities to routinely analyze milk samples for MUN. Test strips also are available for cow-side usage. However, they are not as accurate as results from laboratory run-tests and these strips can not easily distinguish between normal values and a moderately high MUN value.

Table 3. Interpreting MUN results based on stage of lactation and milk protein percentage..

Stage of Lactation	**Milk Protein %**	**Low MUN (< 12 mg/dl)**	**High MUN (> 16 mg/dl)**
First 45 days of lactation	<3.0	Low DIP or UIP and low energy	High SIP, DIP-Low Fermentable carbohydrate, High UIP
	3.0-3.2	Low DIP &/or UIP	High DIP, NEl OK
	>3.2	Low DIP&/or UIP, high NEl	High DIP, High NEl
46 to 150 days in milk	<3.0	Low DIP, UIP, NEl	High SIP, DIP in relation to fermentable Carbohydrate, High UIP
	3.0-3.2	Low DIP &/or UIP	Excess DIP
	>3.2	Low DIP, UIP, High NSC	Excess DIP, UIP in relation to fermentable carbohydrate
Mid to Late Lactation (> 150 DIM)	<3.2	Low DIP, UIP, NEl	High SIP, DIP in relation to fermentable carbohydrate, low NEl
	3.2-3.4	Low DIP, UIP	High DIP, NEl OK
	>3.4	Low NEl	High DIP, NEl OK

Source: Presentation made by Dr. Barney Harris

Interpretation of the results: Milk urea nitrogen (MUN) is an excellent tool to help evaluate the success of ration formulation and delivery of that ration to a group of cows. Like other tools outlined in this proceedings, MUN's are designed to help a nutritionist determine the protein status of a group of cows, not individual cows. The concentration of MUN's do vary with stage of lactation, between cows and season of the year. MUN's do not vary with the time of feeding as greatly as blood urea nitrogen values. Scientists differ in their suggested "normal ranges" for MUN's for groups of cows. Cornell researchers suggest that normal values range between 12 to 16 mg MUN/dl with Penn State researchers suggesting 10 to 14 mg MUN/dl and an Illinois scientist widening the normal range to include 12 to 18 mg MUN/dl. All scientists concur that individual cows will range between 8 to 25 mg/dl to have averages fall between their suggested "normal values". Table 3 is an adaptation of an excellent summarization prepared by Dr. Barney Harris on how to interpret MUN results.

Body Condition Scoring

Body condition or the amount of fat carried around the rump, tailhead, and loin area can influence milk production, reproduction, health and longevity of cows. Cows which are thin at calving will not peak as high in production as cows in good body condition. On the other hand, cows which calve with too much condition and/or are not managed properly can have calving problems, milk fever, retained placenta, metritis, ketosis or other post-calving problems and will not milk as well.

High-producing cows cannot consume enough feed during the early part of their lactation to support the large amount of milk they are producing. To obtain the necessary amount of energy, they rely on their fat stores as a readily available energy source. Cows should not drop more than 0.5 to 1.0 point over a 30 to 40 day period in early lactation. When fresh cows drop a point in the first two to three weeks into lactation, a major feeding and management problem is indicated.

Cows should be fed to regain body condition in later lactation. A typical mature cow will gain 4 to 5 pounds of body weight weekly. To increase by one body condition score, a mature cow will need to gain 120 lbs of body stores which will take approximately six months. First-calf heifers require 160 lbs of added body weight to regain one body condition score.

Scoring the amount of body condition cows and heifers are carrying for their respective stage of lactation is an excellent management tool for fine-tuning a feeding and management program. In herds where more than one cow deviates from the expected body condition score, changes are necessary in the energy and protein density of the diets and/or changes are needed in management to correct low dry matter intake. The amount of body condition a cow is carrying needs to be related to the stage of lactation of the group of cows. Just looking at the amount of condition cows are carrying without knowing their calving date and breeding history reveals very little about how well the nutritional and management program is working. Table 4 gives the suggested body condition score by stage of lactation and some possible nutritional and management areas to address to correct the deficiency or excess body condition observed.

Table 4. Suggested body condition score (BCS) for cows at different stages of lactation with suggested areas to review if cows deviate from suggested score. Dairy cows are scored from 1 (thin) to 5 (overly conditioned).

Stage of Lactation	Ideal Score (Range)	Trouble Shooting Problems
Calving	3.5 (3.0-3.75)	Low BCS: Review dry cow program-low energy intake
		If going dry thin: Review energy intake in later lactation
		High BCS: Long dry period, long days open, excess energy intake in later lactation
Early lactation	2.5-3.0 (2.0-3.0)	Cows should not lose more than 0.5 BCS in 6 weeks time
		Thin BCS first 2 weeks: Review transition into herd from dry lot
		Thin BC early lactation: Check energy density of diet. Check dry matter intake.
		High BCS: Check for deficiency of protein, DIP and UIP
Mid-lactation	3.0 (2.5-3.0)	Low BCS: Check energy density of diet. Measure dry matter intake as it related to balanced ration
		High BCS: Check protein content of diet, decrease energy density of diet
Dry off	3.5 (3.0-3.75)	Low BCS: Review energy density of milk cow diet
		High BCS: Excess energy or protein intake in late lactation, long number of day open (later lactation cows may need to be grouped)

Urine pH of Close-up Dry Cows

The inclusion of anionic salts in close-up dry cow diets has been shown to decrease the incidence of metabolic and other health problems associated with hypocalcemia or milk fever around the time of calving. Close-up dry cow diets formulated for a negative dietary cation-anion difference will cause a mild metabolic acidosis, which in turn, increases the mobilization of calcium from bone and may even increase the absorption of calcium from the gut. These metabolic changes will help maintain a normal concentration of calcium in the blood and prevent milk fever and subclinical hypocalcemia (low blood calcium).

Beede (1996) has suggested that monitoring the urine pH of close-up dry cows is an effective diagnostic tool to decide if anionic salts should be added and a practical means to adjust the amount of anionic salts necessary to achieve a beneficial response. Urine pH can be measured on farm using standard pH paper or a portable pH meter. The target urine pH for close-up dry cows is between 6.5 and 5.5.

If the pH of the urine is 6.5 or greater, the addition of anionic salts to the close-up dry cow diet would be indicated. The next step would be to rebalance the close up dry cow diet to supply a negative dietary cation-anion difference. Information on balancing rations for a negative cation-anion difference was covered by Dr. West at the 1994 Kentucky Ruminant Nutrition Workshop. After this reformulation and after this negative dietary cation-anion ration was fed for at least 7 to 10 days, the urine pH of at least four cows would be remeasured and the amount of anionic salts adjusted until the urine pH is between 6.5 and 5.5, depending on the breed.

Putting These Tools Into Practice

When trying to diagnosis the causes of a suspected nutritional problem, it is important to use a combination of discussed tools. At least 10% of cows should be evaluated. Once the problem area is determined, the ration and/or feeding management should be changed to correct the suspected problem. Once the changes are made it is imperative to continue to monitor the situation even after the desired results are obtained. Fine-tuning feeding programs for the milking herd and dry cows is a dynamic process which must be changed and fine-tuned frequently to obtain the desired results.