Tools for the Veterinarian to Increase Herd Performance and Profitability

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Cow health continues to be a key focus point for dairy managers and veterinarians. Production medicine reflects the need to zero in on factors that improves profitability rather than treat sick animals. Several "hot topic" areas in the field are discussed to fine tune production medicine.

Measuring Effective Fiber and Using It to Improve Herd Health

Chemical and functional fiber should be considered when deciding which fiber sources are needed. Chemical fiber is that fraction that can be analytically measured, predicts energy content, and is an index of feed quality (ADF, NDF, or crude fiber). ADF is an indicator of digestibility and energy content of a feed. NDF is used as an index of bulk and intake in a dairy ration. Both ADF and NDF values are useful in balancing rations and predicting dry matter intake (Table 1).

Table 1. Guidelines for carbohydrate requirements (Hutjens, 1994).

Nutrient	Level (% D. M.)
Acid detergent fiber (ADF)	>19
Neutral detergent fiber (NDF)	>28
Effective NDF (eNDF)	>20
Forage NDF	>21
Forage NDF (with fuzzy cottonseed)	>19
Non-fiber carbohydrate (NFC)	<40

Functional fiber is that portion of the ration fiber that maintains normal rumen function and motility, forms the forage or hay raft in the rumen, and stimulates cud chewing. Physical form or fiber length is needed to make the dairy cow "work". Processing of feed (forages and grains), level of forage, type of feed, and feed delivery system can result in a shortage of effective fiber in the ration. The following signals could indicate a shortage of effective NDF (eNDF).

1. Milk fat and milk protein test inversions. Significant inversions occur when more than 10 percent of the cows have milk protein tests 0.4 point or more higher than milk fat tests (for example, 3.2% protein and 2.7% fat).
2. Loose manure. If manure droppings are more fluid, rate of passage may be high and fiber form lacking (excess protein and mineral can also cause this symptom).
3. Lack of rumination. When cows are resting, more than half of the cows should be ruminating. Cows must ruminate and chew a minimum of 550 to 600 minutes a day to produce adequate amount of sodium bicarbonate and stimulate rumen digestion. Each bolus should be chewed 40 to 60 times before reswallowing.
4. Free choice consumption of sodium bicarbonate. While research is limited, cows may aggressively consume free choice buffer when given the opportunity.
5. Laminitis. Cows that have sore feet and abnormal foot growth may have experienced rumen acidosis which could be related to a lack of eNDF.
6. Response to buffer. Adding .3 to .5 pound of sodium bicarbonate or its equivalent to ration improving dry matter intake, milk production, and/or fat test could indicate a shortage of fiber.
7. Variable dry matter intake. If cows exhibit wide variations in dry matter intake, a lack of fiber may impact rumen digestion.

Several approaches can be used to evaluate if cows are receiving adequate effective fiber. Most methods use one or more chemical fiber values while others are strictly physical measurements. Wisconsin researchers suggest 21 percent NDF from forage sources or 19 percent if fuzzy cottonseed is added to the ration at 5 to 6 pounds per day. For example, 21 percent forage NDF guide divided by .45 (45% NDF in the total forage program) equals a minimum of 47 percent forage in the total ration dry matter. If a cow consumes 50 pounds of dry matter, she consumes 23.5 pounds of forage dry matter per day. Another guideline is 0.9 percent of the cow's body weight as forage NDF. For example, a 1300

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pound cow times .009 (0.9% expressed as a decimal) equals 11.7 pounds of forage NDF. If forages contain 45% NDF, a cow needs 26 pounds of forage dry matter (11.7 divided by .45) to meet her forage NDF needs. Both calculations imply all forages have comparable eNDF value.

A new approach was suggested by Cornell workers calculating effective NDF in the total ration. All feeds (forages and concentrates) are adjusted based on the fraction of feed that remains on a 1.18 mm screen. These values allow the user to adjust all NDF (Table 2). Balance for 21 percent effective NDF in the total ration dry matter.

Table 2. Effective NDF values for feeds (adapted from Sniffen, 1988)

Feed	Level of NDF (% of D. M.)	Effective NDF (% of NDF)
Alfalfa hay	40-55	92
Alfalfa haylage (course)	40-55	80*
Alfalfa haylage (fine)	40-55	40*
Alfalfa pellets	40-55	10
Grass hay	45-65	98
Corn silage (<1/4 TLC)	45-55	61*
Corn silage (1/4 TLC)	45-55	71*
Brewers grain	42	18-33
Fuzzy cottonseed	44	75-100
Soybean hulls	67	2
Distillers grain	44	4
Soybean meal	16	23
Hominy	25-51	2
Wheat midds	51	2
Shelled corn, whole	9	100
Shelled corn, rolled	9	60
Shelled corn, ground	9	48
Ear corn, ground	28	56
Oats, ground	32	34

* When using the Penn State Separator, subtract the percent in the bottom box from 100. For example, a haylage with 55 percent in the bottom box would have an eNDF of 45 percent (100-55).

Wisconsin workers developed an objective measure of haylage particle size. A mechanical shaker containing five screens and a pan sizes haylage, corn silage, and TMR to determine if adequate length is present to support rumen function. Over 15 to 20 percent of the forage should remain on the top two screens when the sample is physically separated by shaking for five minutes. Only 31 percent of TMR and 30 percent of haylage samples measured from Jan to April, 1996, were long enough to support rumen function and meet minimal forage particle length. Individuals can have their forages and TMR measured by sending a gallon sample to Dairyland Labs, 232 Main St., Arcadia, WI, 54612 ($12 per sample).

Penn State ag engineers and dairy scientists developed a three box unit to measure forage particle size in the field. The Penn State Forage Separator is commercially available from NASCO (800-558-9595, number C15924N) for $195 ($240 including a scale and weighing containers, number C15926N). The procedure involves shaking the box unit 40 times rotating the unit a quarter turn after five horizontal shakes allowing shorter particles to drop through the top two screens. Table 3 lists the current Illinois guidelines to evaluate haylage, corn silage, and TMR. The top box in the Penn State Separator is comparable to the top two screens in the Dairyland Lab procedure. The haylage guideline applies to rations based on haylage as the only source of effective fiber. Fuzzy cottonseed is captured in the middle box if adequate shaking has occurred and the top box was not over filled. Overfilling boxes can result in poor separation as some feed is not exposed to the screen opening. Larger sample sizes of shorter feeds can be shaken initially. Percent of forage in the top box measures effective fiber. The second and third boxes evaluate the range of shorter material present impacting rate of fermentation and passage. When evaluating wet silage, the three boxes will have similar dry matter percentages which allows for direct weighing and interpretation. However with TMR, wet forages (silage at 60% moisture for example) and dry grains will bias the percentages as dry matter is not uniform.

Table 3. Illinois guidelines for Penn State Separator box results.

		Screen distribution (as is basis)		
Type of feed	**Amount**	**Top**	**Middle**	**Bottom**
	(lb as is)	--------% by weight--------		
TMR	3/4	>10	30-50	<50
Haylage	1/2	>20	20-50	<40
Corn silage	1	<5	>50	<50

Commodity Feeding: Positioning and Pricing

Commodity feeds continue to be a popular topic as more TMR systems are adopted, interest in reducing feed costs builds, and the need to add sources of digestible fiber and protein increase. By-product feeds (also called co-product feeds) can be used by farmers in conventional barns, small herds (less than 50 cows), and should not be a threat to feed companies or cooperatives. Dairy farmers should consider two key points when deciding if and when to use by-product feeds.

1. Price. If the producer can have a commodity feed delivered to the farm cheaper than alternative feeds, it should be considered. Feed Val 3 is a spreadsheet program that calculates the break even price for feeds based on energy (shelled

corn), by-pass protein (44% soybean meal), fat (tallow), phosphorus (dicalcium phosphate), and calcium (limestone). Table 4 lists break even price for commodity feeds. Other factors such as improved cow health (less rumen acidosis or ketosis), desirable milk component shifts (higher milk protein or fat test), and more milk should also be considered.

2. Positioning. If the commodity feed is needed in the ration, it should be added. The following nutrient profiles can be considered.
   - By-pass protein (roasted soybeans, corn distillers, or blood and bone meal are examples)
   - Degradable protein (raw soybeans, corn gluten feed, or canola meal are examples)
   - Effective fiber (fuzzy cottonseed is an example)
   - Digestible fiber (soyhull, beet pulp, corn gluten feed, or wheat midds are examples)
   - Fat as an energy source (cottonseed, soybeans, canola seed, or distillers grain are examples)

Commodity feeds historically have been viewed as competition for the feed industry. In the midwest where feed grains are raised or locally available, complete 12 to 20 percent grain mixes are less common (commodity feeds compete with this feed tonnage). Feed suppliers are finding commodities are an excellent business.

1. Feed companies and cooperatives can buy commodity feeds in larger quantities and at optimum times resulting in good buys which allows for profit margins and give dairy farmers a good buy.
2. Smaller farmers cannot handle, store, or pay for semi-load quantities of several commodities on the farm. Many farmers want the benefit of commodities which a feed company or cooperative can provide.
3. Larger farms may want the convenience of a blended 3 to 7 pounds of feed which includes 2 to 5 feeds plus minerals and vitamins that can be handled as one bulk ingredient.

Table 4. Break even prices (using Feed Val 3 at various prices for soybean meal and shelled corn; tallow at $.29/lb, dicalcium phosphate at $20/cwt, and limestone at $7/cwt) and suggested feeding levels of by-product feeds.

Protein by product feeds	**(corn priced at $3/bu)**			
	-----Price ($/ton)-----			**Level (lb/day)**
Soybean meal (44%)	225	275	325	As needed
Soybean meal (48%)	240	297	355	As needed
Blood meal	628	840	High	.5 to .75
Brewers grain	194	233	271	5 to 10
Corn gluten meal	432	557	682	1 to 3
Distillers grain, corn	230	269	308	2 to 5
Fish meal	592	747	High	.5 to 1
Soybeans, heat treated	327	389	452	4 to 6
Soybean meal heated (SoyPlus)	342	418	520	As needed

Energy by-feeds (44% soybean meal priced at $225/ton)	**---(Shelled corn ($/bu)---**			
	2.00	3.00	4.00	Level (lb/day)
	----Price ($/ton)----			
Corn gluten feed	102	130	158	5 to 10
Cottonseed, fuzzy	208	222	235	5 to 6
Hominy	87	120	152	5 to 10
Molasses, dry	Low	66	111	2 to 4
Soy hulls	55	91	126	5 to 7
Wheat midds	86	113	141	5 to 7

Dairy farmers must recognize that when commodities are purchased in place of commercial feeds, someone must take the responsibility to correctly use these feeds. Midwest consultants charge of 10 cents per cow per day or $2 per cow per month. With a 60 cow herd, this represents $150 to $180 per month. The following costs would be parallel to this charge.

- $40 per hour (1/2 day of time per month or $160)
- $50 service charge per ton of protein supplement ($.10 per cow at 4 lb/cow/day)
- $200 service charge per ton of mineral supplement ($.10 per cow at 1 lb/cow/day)

These charges may include forage testing (3 samples per month at $9 to $20 per sample), ration balancing, and/or monitoring commodity feed quality (nutrient variation, dry matter content, and mycotoxin).

Milk Urea Nitrogen (MUN)-- Using and Interpretation

Protein is an expensive nutrient ($0.33 per pound of crude protein based on soybean meal at $300 per ton). Ration protein levels are increasing for several factors.

- Milk yield per cow continues to increase
- Emphasis on component pricing
- Rations primarily based on high quality legume forages
- Legume-grass forage quality varies
- Lower dry matter intake in early lactation
- Added fats do not support microbial protein synthesis
- Mobilized body fat in early lactation

But, higher levels of dietary protein causes problems (health, production, or reproduction) if not balanced or used as intended. Measuring rumen ammonia, blood urea nitrogen, uterine urea nitrogen, or milk urea nitrogen could be useful management tools to evaluate protein status. MUN tests are available through DHI and private labs.

MUN is the portion of nitrogen in milk in the form of urea (compared to casein and whey proteins). As the level of blood urea nitrogen (BUN) increases, the level of milk also increases lagging blood levels by 2 hours. MUN has been found to be 83 to 98 percent of the BUN concentration. Cornell workers suggest dividing MUN by 0.85 to estimate BUN. If ammonia is not utilized by rumen microbes (converted to microbial protein), it is absorbed across the rumen wall and into the blood. Blood ammonia can shift blood pH and be toxic to the animal. The liver converts ammonia to urea, releasing it in the blood as BUN, and excreting it in urine (major route), milk (as MUN), and uterine fluid, or recycling to the rumen by saliva. High levels of MUN can reflect several nutritional problems.

1. Protein imbalance with high levels of total protein, excessive degradable intake protein (DIP), high or low undegradable intake protein (UIP), amino acid imbalance, and/or excess soluble intake protein (SIP).
2. A shortage of rumen fermentable carbohydrate (CHO) including starch, pectin, or sugars to capture available rumen ammonia as microbial protein.
3. Suboptimal rumen microbial environment reducing microbial growth (low pH, no forage mat, abnormal volatile fatty acid profile, or slow rate of passage).

Low levels of BUN can reflect inadequate ammonia in the rumen for optimal microbial growth leading to protein shortage in the cow.

Cornell workers suggest herd levels less than 12 and over 16 mg/100 ml can reflect losses of nutrients, higher feed costs, health effects, and reduced milk production. Individual cows MUN can vary greatly (values as low as 1 and over 30 mg/100 ml). Summarizing 10 or more individual cow MUN values is suggested (this approach may reflect MUN within 1 to 2 MUN units of the group value). A range of 12 to 18 mg/100 ml is desirable for groups of cows. If group MUN values are over 18, several losses can be occurring.

1. Significant energy losses occur when a cow must convert ammonia to urea and excrete it in urine. Using the Cornell model and a diet that predicts MUN over 20, seven pounds less milk would be produced as energy was diverted from milk production to urea synthesis.
2. Purchased protein supplements excreted as urea could cost 20 cents per cow per day (two pounds of protein supplement at 15 cents per pound used as an energy source compared to two pounds of shelled corn valued at $0.05 per pound).
3. New York and Pennsylvania workers have reported that high levels of BUN can reduce conception rate due to energy loss in early lactation (negative energy balance), change of pH in the uterus, and/or mineral shifts in the uterine lining.
4. High levels of protein can affect cow health and the immune system, especially in cows with metabolic problems.
5. High BUN levels have an environmental impact as excessive nitrogen is excreted impacting water and air quality.

While some nutritionists will focus MUN on reducing reproductive risks, research results in this area are variable. Energy losses and feed savings will be significant field uses for MUN.

MUN can be run to establish a base line value and compare when a major ration change has occurred or a protein related concern may be occurring.

- Feeding cows lush pasture
- New forages are fed
- Changes in the levels of total, undegradable, degradable and/or soluble protein in the diet
- Shift in the particle size or moisture content of grain
- A decline in conception rate
- Low milk protein test
- Change in fecal consistency or odor

Test the entire herd if an economical lab is available to get a MUN baseline for future comparisons and changes. Review MUN levels in the high producing, first lactation, and other groups to see if MUN patterns exist. MUN values in cows fresh less than 35 days are variable and difficult to interpret.

Processing Corn for Optimal Rumen Function

Depending on the type of starch and grain processing, starch can be rapidly degraded in the rumen or escape from the rumen and be digested in the small intestine (as a source of glucose) or pass through the entire digestive tract and appear in the manure. Depending on the ration ingredients, dry matter intake, and level of milk production; the site of starch digestion is critically important.

A study conducted at Farmland Industries is summarized in Table 5. Milk production was increased by six pounds per day with higher milk components and body weight gain due to finely processed corn. Diet one was cracked corn (2213 micron or 85,000 particles per pound). Diet three was ground fine (773 microns or 9.5 million particles per pound). Diet two was a mixture of half of each type of processed corn. These cows were in mid lactation and corn was limited to 14 pounds and

Table 5. Effect of corn processing on milk production and weight change.

	Corn Processing		
	Cracked	**50/50**	**Ground**
Milk yield (lb/day)	69.2	72.2	75.3
Milk fat (%)	3.59	3.64	3.73
Milk protein(%)	3.19	3.26	3.29
D. M. intake (lb/day)	49.0	50.6	50.7
Weight change (lb/day)	+.34	+.60	+.67

mixed in a TMR. Similar results have been reported with steam flaking of grain and processing high moisture corn finer. Last year, several dairy farmers and feed companies also reported excellent milk production increases with feed grade starch (talcum powder fine and dusty).

To evaluate grain particle size, a series of three sieves and a pan can be used in the field. These screens are standard sieves and are commercially available.

Screen	Size (micron)	Sieve No. (U.S. std)	Corn appearance
Top screen	4750	#4	Whole corn/large pieces
Second screen	2360	#8	Cracked/chips
Third screen	1180	#16	Ground
Bottom pan	Pan	Pan	Powdered

The U.S. Standard Sieves can be ordered from Fischer Scientific for $45 (brass) each and a brass pan for $26. Our suggested guidelines are no corn on the top screen (will come through the entire digestive tract and appear in manure), one third on the second screen (fermentation is delayed in the rumen and more starch is available in small intestinal digestion), one third on the third screen (mostly fermentation in the rumen), and one third on the bottom pan (rapid source of fermentable starch in the rumen and can jump start the bacteria). The type of forage (high corn silage would favor a coarser particle due to high starch levels in silage) and type of starch (corn and milo starch are slower in the rumen compared to barley and wheat starch sources). Guidelines for high moisture corn would also be different because the starch is more available due to fermentation in storage.

In the field, the following observations may be helpful to determine optimal grain particle size when making grain processing changes.

- Measure milk production changes
- Measure dry matter intake changes
- Manure score changes
- Examine washed manure
- Changes in MUN
- Watch for signs of rumen acidosis

As grain is processed finer, lower levels of corn (starch) may be needed. High legume-grass based forage programs could benefit from more ruminally available starch. If a TMR is not fed, finely processed grain may be unpalatable due to dusty feed or the formation of paste in the cows mouth.

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