Dairy Split Session III

Moderator - Meg Cattell

On-Farm Nutrition Diagnostics

Nutrition Management Involvement Opportunities for Dairy Practitioners

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Introduction

Veterinarians are held in high esteem by cattlemen in this country. Rockwood Research, Inc. conducted a study for Church and Dwight of 700 dairymen, asking their preferred sources for information on new nutritional products.[10] Dairymen ranked veterinarians highest of all the sources. (Figure 1). Yet, we as cattle veterinarians, have too little direct involvement with nutrition management (Figure 2), as demonstrated in the 1993 AABP survey of member veterinarians.[1]

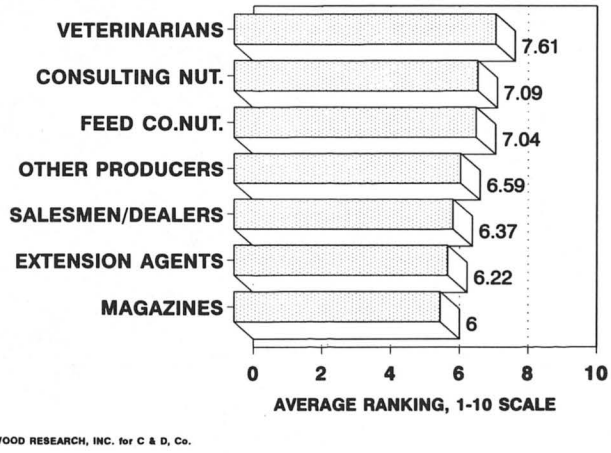

Figure 1. Sources of Info on New Feed Ingredients *Ranked By Dairy Producers.*

With feed and forage costs totalling 45-60% of milk checks, dairymen need excellent management control of nutrition to minimize feed cost and to maximize production, reproduction and cow health. Figure 3 shows the categorization of expenses for the most profitable quartile of herds on Northeast Agrifax financial records system.[9] These herds averaged 116 cows and sold 19,030 pounds per cow per year for the years 1992-94. Crop expense and off-farm feed expense averaged $6.44/cwt on milk that was sold at $13.61/cwt. Nutrition input costs, $3.73/cwt for off-farm feed and $2.71/cwt for on-farm production of forages and grains, dwarf all other expense categories.

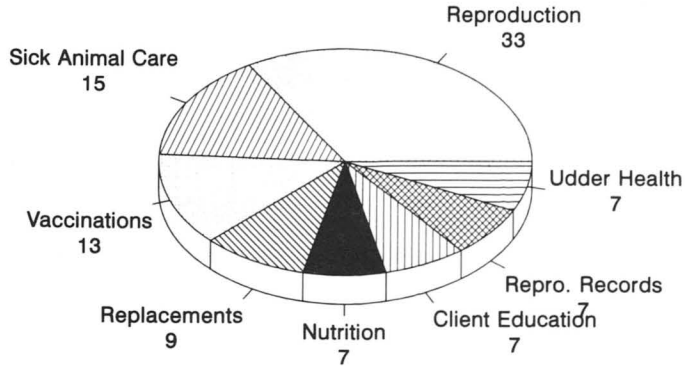

Figure 2. Percent of Professional Time, AABP Member Survey, 1993.

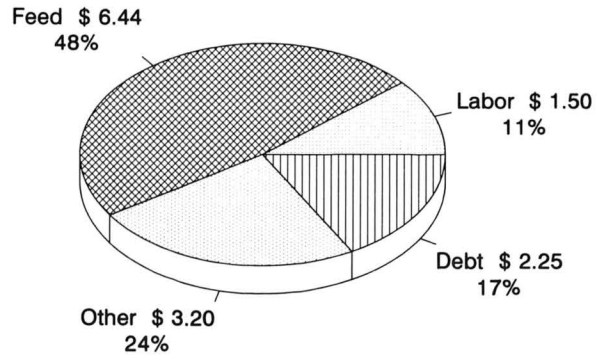

Figure 3. Agrifax Northeast Top 25% Profit Group Expense Categories / CWT: Averages for 1992-94.

Veterinarians, as nutrition management consultants, can offer valuable input into nutrition management from a **totally** independent, non-product-oriented vantage point. Modifications in nutrition management can reap large benefits in reduced feed cost, increased production and cow health.

In Dairy Production Consultants[5] seminars on nutrition and records, we emphasize categorizing opportunity areas into one of four cow management divisions:

P - Production
U - Udder Health
R - Reproduction
R - Replacements

If a dairy manager controls inputs and outputs in each of the PURR categories, the business will "purr". All areas need proper management control, but nutrition and production control reaps the largest economic responses and those results are realized in the shortest length of time. This is the reason for the order in "PURR".

Why Nutrition Diagnostics?

Many computer formulated rations fail to perform due to difficulties in management of cow comfort, feeding behavior, or simply the pitfalls of getting the right ration off of the paper and out to the cows. Four rations exist at a given time for each group of cows or heifers on a dairy farm:

1. Ration on paper
2. Ration fed
3. Ration eaten
4. Ration digested

The goal of nutrition management is to make sure that all four rations are as identical as possible every day.

Nutrition diagnostics are an avenue to evaluating nutrition management. Ration evaluation can be directed by three questions:

1. Is this ration healthful?
2. Will this ration support the desired production?
3. Is this ration economical?

Nutrition diagnostics can be split into two categories: 1. Computer ration analysis and 2. cow performance assessment (cow consulting). Cow consulting occurs through collection and analysis of information through various pathways: a. on-farm diagnostics, b. DHI records, c. shipped milk quality records, and d. checkbook results. The cows do know and they always tell the truth. Cows tell us like it is, not as we wish it to be, not as we perceive it to be, not how it once was, but how IT IS!

This presentation concentrates only on the "on-farm" consulting of the cows. None of the nutrition diagnostic techniques discussed here require a computer. It is my opinion that much of the potential progress in nutrition management has less to do with computerized ration formulations or diagnostics, and more to do with quality forage production, economic purchases, inventory control, cow comfort, and the consistent mixing and delivery of rations of known quality and quantity. Veterinarians are poised with the trust of the dairyman, and the diagnostic and information organization skills to jump into nutrition diagnostics and make large impacts for the dairies that we serve.

Specific Diagnostic Techniques

Cow Comfort Quotient

Cow Comfort Quotient (CCQ) is a crude assessment of the stall and bedding comfort on a dairy at a given time. To calculate the cow comfort quotient simply count the cows that are in stalls and the cows that are lying in stalls properly.

CCQ = cows lying properly / cows "in" stalls x 100.

Notice that this equation ignores the cows that are standing in the alley or at the feed bunk. It is an attempt to assess how many cows exerted the effort to walk to a stall, lie down and get comfortable. An "in stall" cow is defined as a cow that has two feet in a stall. Cows lying half in half out, lying backwards, standing with two front feet in the stall are all "in stall" cows. The suggested goal is at least 80%, with well-managed cow comfort herds at 85-90% almost any time that they are checked. Cows should be lying down at least 11-12 hours a day which approximates the required cud chew-

ing time to maintain normal rumen health for today's high producing cows.

Time lying down probably impacts production in two major ways: A. Blood flow through the mammary gland in cows that are lying is improved by 27% versus cows that are standing.[11] See Figure 4. All nutrients for production of milk are delivered to the mammary gland through the blood stream. This may be a leap without complete data, but I assume that cows that lie for longer periods of time and more often during the day will produce more milk; B) Stall comfort has a dramatic impact on incidence of laminitis, even on the same ration. Work in England[4] showed conclusively that amount of bedding influenced the number of milking heifers with laminitis in one of two herds owned by the same owner and fed the same rations with identical stall design and size. The only difference between these two dairies in management was that one used four times the bedding that the other one used. Bedding was chopped straw on top of concrete stalls. See Figure 5 for a summary of this field study.

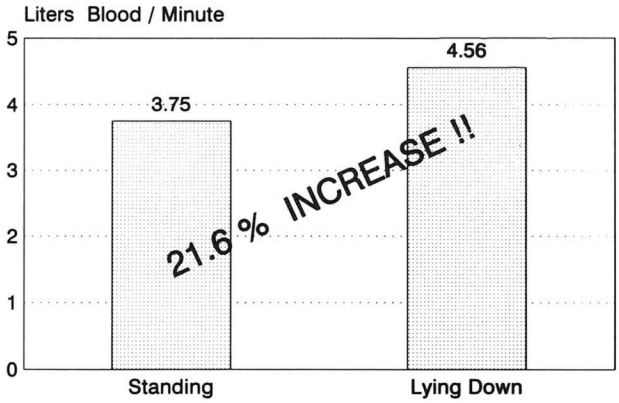

Figure 4. Mammary Blood Flow: Milking Cows, Standing vs Lying Down.

	Herd A	Herd B
Stalls/bale	42	11
No. Heifers	25	30
# Heifers with Laminitis	10	0
# Heifers stand 2 hrs	4	0
Ave. minutes to lie down	24	12
Ave. percent standing	54	37

Figure 5. Laminitis: Two Herd Comparison

Many poorly designed stalls become suddenly *vastly improved* with adequate amounts of bedding. Bedding must serve two functions; 1. **"shake -n- bake"** to keep cows clean and dry, and 2. **padding** for body comfort and the "invitation to lie down".

Cow comfort quotients obtained in 16 Dairy Production Services client herds in 1991 averaged 81% on CCQ with the top 3 herds in production averaging 91% on each of three visits to the dairies in a three month time period. Too little bedding or poor stall design or overcrowded barns, or extended holding area times obviously add to cows spending more time on their feet. If a cow finds it difficult to lie down or to rise, she is hesitant to carry out the desired routine of eating many meals in a 24-hour period.We need to discourage cows from eating a big meal only after each milking. The further we can get our modern dairy cows away from slug feeding, the better we optimize rumen health and the ability to digest large portions of forage in the cows diet. My two highest producing herds in 1996 have been two herds with excellent cow comfort and with very high forage diets(60-62% forage). The forage is excellent on these dairies, yet there are two main underlying reasons that such high forage diets work. The cows are comfortable and the dairymen have been willing to challenge cows to eat more and more forage with the confidence that our production monitoring system will tip us off when we go too far. This has been extremely valuable in minimizing off-farm feed costs.

Dr. Al Kunkle recently published an article expressing what TMR feeding has taught him.[6] I applaud and echo his theories and conclusions based on consulting the cows. He believes that cows will eat more dry matter in a TMR situation, and therefore can be fed less grain. He believes higher fiber levels are needed to ensure health and performance. Figure 6 shows the results that higher DMI will have on required energy density of a lactating diet. A 5.3% increase in DMI results in a drop from .80 to .76 mcal/#DM in necessary energy density.

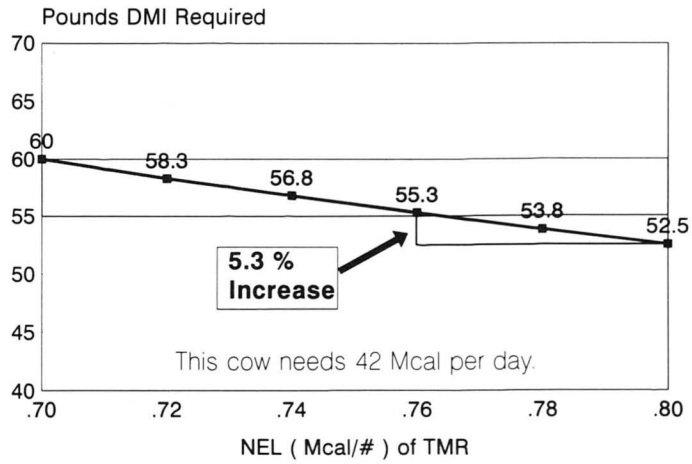

Figure 6. DMI Required for Energy Needs, 1350# Cow: 100# Milk.

Cud Chewing Index

The Cud Chewing Index (CCI) is assessed in a herd at the same time that the cow comfort quotient is. This is done merely by finding the ratio of cows that are lying down comfortably in stalls versus the number that are chewing cuds during your spot check. Cows that are sleeping, lying down or getting up from stalls are not included in the denominator because they are "not at risk" for cud chewing.

CCI = cows chewing / cows in stalls x 100

I expect this number to be 50% or higher in herds that are well fed with adequate physically effective fiber in the diet. Many of my comfortable, well fed herds will average 60-65% CCI month after month.

TMR Test Mix

Displaced abomasums ? Acidosis-laminitis ? Butterfat depression ? Any of the above plus high feed bills ? Maybe the cows suffer from too little effective fiber and cannot perform like they are expected to.

Rations can be built that have too little chemical fiber in them. Rations can be built that have too little biologically effective fiber in them. Rations can be built that meet all fiber requirements, but the cows do not receive the ration on paper. They get it after several potential things can go wrong. *It is our job as nutrition management consultants to be sure that all four rations match.* The ration digested by the cows is the only ration that dictates results in health, production and reproduction. Unless these rations match to the best of our abilities, records analysis and other nutrition diagnostics will not **appear** to tell the truth. Until management of nutrition is good enough to guarantee that the four rations match, many dairymen will not see the connection between performance and the little nutrition management details...how can they?..they DO NOT KNOW what their cows are eating and digesting. Without knowing where you are now, you can't begin to go where you want to go.

TMR mixers have been a tremendous tool for dairy nutrition management. However, like any other tool, mixer wagons can be poorly managed. When an auger mixer is overloaded, has badly worn augers, or mixes too long, effective fiber can be destroyed. This results in sub-optimal rumen function, poorer production, and increased digestive disease.

A simple test can be done to diagnose mixer abuse of forages and fiber. The TMR test mix is performed with a spring scale, plastic buckets or a weighing tarp, a grain shovel, a dry floor, and some exercise.

HINTS:

1. Abused fiber TMRs will feel much wetter than they really are...moisture is released from the fiber of the silages when they are mashed.
2. ALWAYS have the dairy manager participate when conducting this TMR test mix. This test can be so dramatic that many will not believe the test was done accurately, unless they participated !
3. This problem is difficult, if not impossible, to have if one uses a reel, paddle, or tumble mixer. Auger mixers are the typical problem.

Each feedstuff fed to one cow for one day is collected and weighed. Afterwards, the TMR is mixed by shovel on the dry floor. Comparing the appearance and feeling of the TMR test mix with the "same TMR" as it is delivered from the mixer will often point out the "mixer abuse."

Many dairies have simply grown beyond the capacity of their TMR mixers. Overloading will lead to extended mixing times, which leads to fiber abuse. We have witnessed good managers accept as routine that the mixer has to run for 10-15 minutes in order to get all the silage into the TMR mix ! The space is increased in the mixer because the fiber is mashed up and the normally turgid fiber is collapsed. Any mixer should mix a TMR in 5-6 minutes of mixing time or less. Feedstuffs should be weighed, then gently and thoroughly mixed with a mixer. Make sure your TMRs are not Measured and MASHED!

Shaking the mixer TMR and the test mixed TMR through a particle separator can add more quantitative results to the TMR Test Mix. I have been using Dr. Britt's Particle Separator.[2] Certainly, more study is necessary on the use of particle separators, but currently they are an excellent "magnifying glass" for ration diagnostics, and an excellent client education and motivation tool.

Rumenocentesis

Tapping the rumens from 6-7 cows in each of two DIM categories has been a very effective method of consulting the cows. Thanks to Dr. Ken Nordlund and colleagues at University of Wisconsin College of Veterinary Medicine, we practitioners have a tool to end the arguments regarding levels of "effective fiber" necessary for rumen health. Rumen pH gives us a reliable direct method of diagnosis. Do you want non-veterinarians doing this procedure, or should we take this opportunity to get involved in the prevention of the most pervasive nutritional sin in the United States, perhaps the world? YES, laminitis! The LF Syndrome (Figure 7) is extremely common. Insidious in onset in many herds, it happens easily because an increase in dietary

grain almost always increases milk. Increases in forage almost always decrease milk ...in the short run. Impatience bred from economic pressures and production-driven dairy philosophies have created too many acidotic-laminitic herds in our industry. It is MUCH easier to add grain to a needy ration than to gently wean a herd off of diets too high in concentrates. Forage digesting bacteria require 7-10 days to significantly change their numbers. Grain digesters can greatly change their numbers within hours.

- Low Forage
- Low Fiber
- Low Milkfat
- Lame Feet
- Low Fertility
- Lost Farm

Figure 7. L. F. Syndrome

Let's be part of the solution, or we will be asked to get out of the way by the very best clients we can have...the best dairymen. They will straighten out this acidosis-laminitis management with or without us. I am convinced that they will control this problem more quickly with our educational and diagnostic skills. Let's just do it!

Technique for rumenocentesis has been described elsewhere.[8] I offer four suggestions:

A. *I recommend four people for efficient operation:*
1. Head restraint operator
2. Tail restraint operator
3. Meter reader and recorder
4. Veterinarian doing rumenocentesis

Having people participate also nearly guarantees that each of these people will truly believe the results! If the dairyman and the feed company representative do not believe the numerous other signs of acidosis-laminitis...make sure that one of them reads the pH meter..allow them to "own the results" of the rumenocentesis. It helps to have the person that is the most against more fiber in the diet read the pH meter..that way they HAVE to come to the correct conclusion..*they* did the measuring...and it is their conclusion.

B. *No anesthesia is necessary.*

I feel local anesthesia is a time waster, and can add to the problems. Timing of restraint is critical and sufficient. As soon as the nose lead is secured, immediately restrain tail and do rumen tap...always in that order, and always exquisitely timed.

C. *Good footing and lock-ups or stanchions has worked well. Without good footing, it can get messy and inefficient.*

D. *If a particular cow reacts unfavorably, skip her. This is a herd diagnosis, and one cow is not worth losing time and patience over.*

Usually, we as veterinarians have much other diagnostic data to guide us to the acidosis conclusion, but usually owners, herdsman, feed company representatives, and nutritionists will quit wasting time arguing over healthfulness of diets when the rumenocentesis results are in.

Example MC Dairy:

MC Dairy had a history of excessive grain feeding with little foot problems due to an extremely comfortable environment for the cows. Fat test typically ran 3.3-3.6%, and cows averaged 70-72 pounds on 3x milking. A trusted feed company representative is very involved with the dairyman and myself in nutrition management. Many discussions have examined all the evidence that suggests sub-clinical acidosis is a problem in this dairy. In May of 1995, permission was granted for rumenocentesis. Results, with 7 of 12 cows yielding pH of 5.5 or less, are shown in Figure 8. Subsequent ration changes, accompanied by an intensively managed new fresh group in June 95, a new close-up dry cow group in October 95, yielded results in adult cow start-up milk improvements seen in Figure 9. All of this change hinged on the dairyman accepting the acidosis as a bottleneck to further production improvements. Local veterinarian, owner, and herdsman participated and "owned the results".

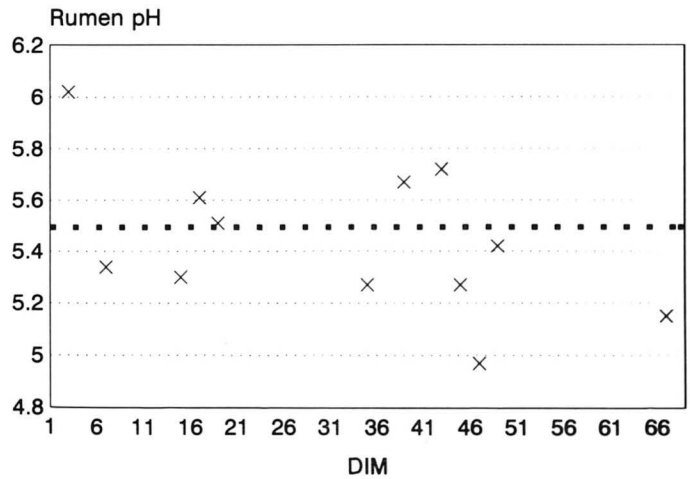

Figure 8. MC Farms: Rumen pH on 12 Cows 24 May 95.

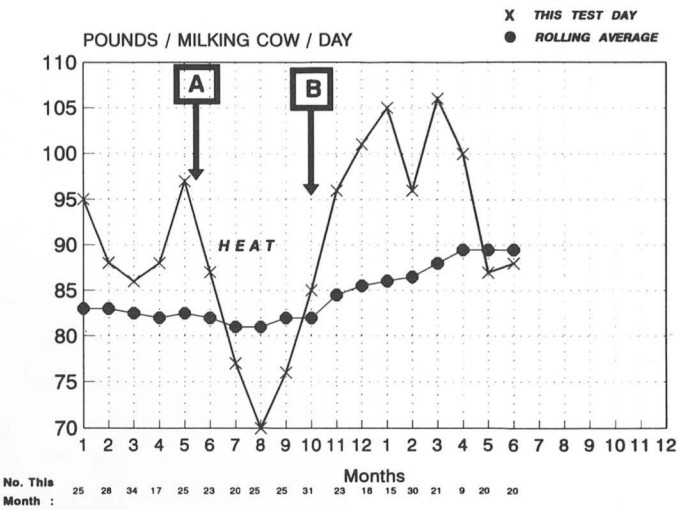

Figure 9. First Test Milk (7-40 DIM) 2nd + Lactations.

MUN

Milk urea nitrogen testing has been a very valuable tool for nutrition management monitoring. MUNs give us a window view into protein/energy utilization in the cow unlike any other monitoring technique. This topic is covered in the accompanying paper: Practical Application of MUN Analyses.[7]

Metabolic Disease

Metabolic disease incidence helps determine profitability of a dairy. In Phil Helfter's words:

"If we can manage 2-3 weeks properly, the rest is easy."

Phil Helfter is the managing partner of Norco Farms, a 600 cow, 33,000 pound producing dairy in Hopkinton, NY. He speaks from experience, with one of the healthiest herds I have witnessed.

Collecting, averaging, and using the incidence of milk fevers, retained placentas, and abomasal displacements has been a records tool in my practice for many years. These are used to demonstrate to clients what should be expected from a well balanced and delivered dry cow nutrition management program. These figures also give me feedback on the effectiveness of my ability to motivate and assist my clients, individually and collectively, in improving their fresh cow heath.

If we, as veterinarians, the *health care specialists*, do not facilitate the keeping, interpretation and use of this type of record, someone else **will**. Let's DO IT.

The denominator in my % incidence figures is *all fresh animals*, cows **and** heifers. Number of freshenings averages 5000-6000 per year in this data set.

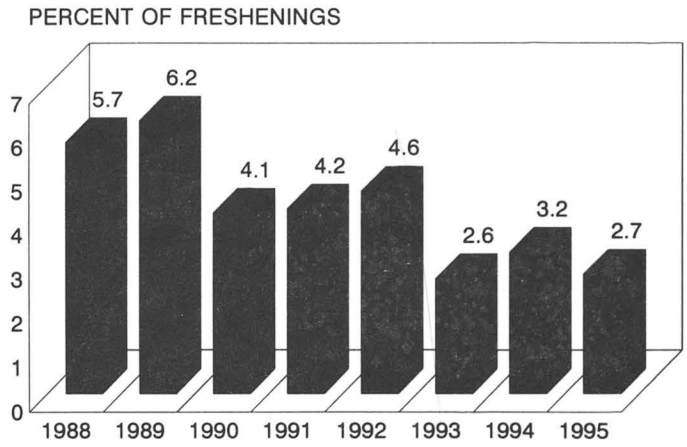

Figure 10. Metabolic Diseases: DPS Contract Herds Milk Fever Incidence 1988--1995.

Milk Fever

I present both the average milk fever incidence (Figure 10), and the high-average-low graph (Figure 11), for a better understanding of the range in the data set. We have made progress in decreasing the average incidence and minimizing the extremes in milk fever, through the use of close-up dry cow diets and heavy adoption of anionic salt technology. Both of these changes occurred in early 1991.

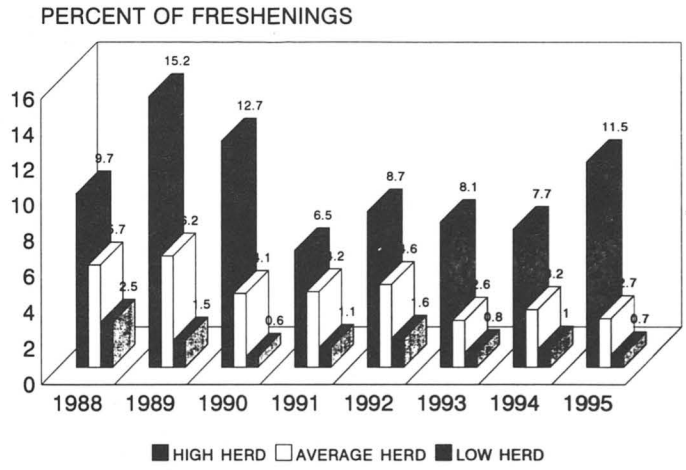

Figure 11. Metabolic Diseases: DPS Contract Herds Incidence Range: Milk Fever 1988--1995.

Retained Placentas

Retained placentas are defined as any cow that is not definitely known to have cleaned within twelve hours of calving. See Figures 12 and 13.

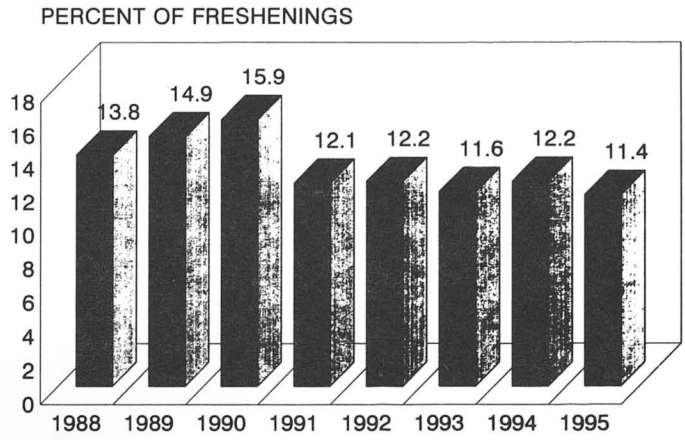

Figure 12. Metabolic Diseases: DPS Contract Herds Retained Placentas 1988--1995.

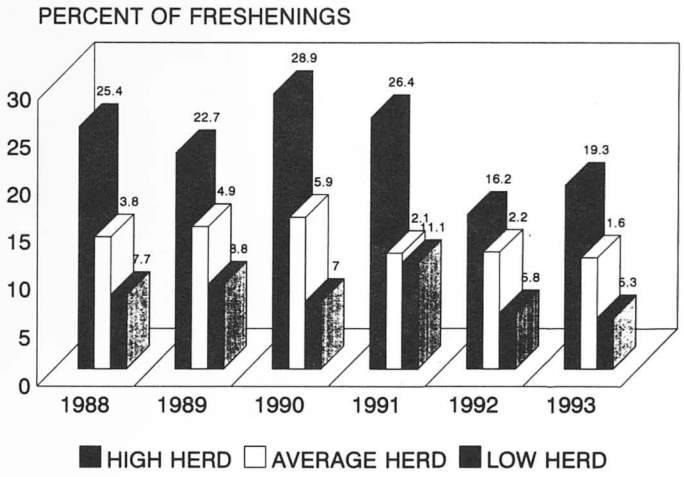

Figure 13. Metabolic Diseases: DPS Contract Herds Incidence Range: Retained Placenta 1988--1993.

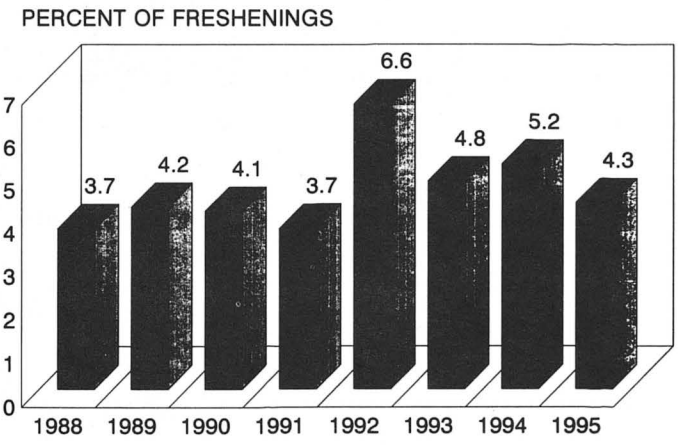

Figure 14. Metabolic Diseases: DPS Contract Herds Displaced Abomasums 1988--1995.

Displaced Abomasums

Displacements increased in 1992. See Figures 14 and 15. I rationalize part of this horrible increase by the fact that two herds are responsible for the incidence being high. Without these two herds, one where I provide only records service, and the other one that never feeds my suggested dry cow diet, the incidence level would be 5.7%, *still too high* ! Our forage was very wet from the 1991 harvest year and contributed to less effective fiber than expected.

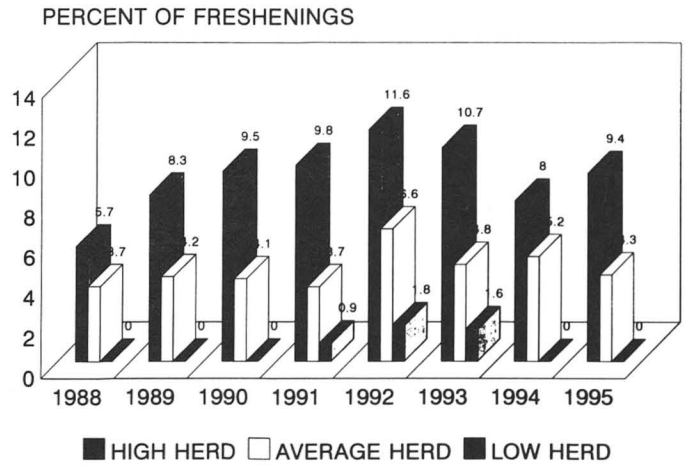

Figure 15. Metabolic Diseases: DPS Contract Herds Incidence Range: Displaced Abomasum 1988--1995.

Urine pH in Close-up Dry Cows

Once again, we have a diagnostic tool that consults the cows directly and inarguably. Since the introduction of anionic salt technology, many herds have "tried it" with at best lack of successful improvement in fresh cow health, and at worst with disaster creation. I offer three possible causes for failure of ANY intervention on dairies:

Possible Causes of Intervention Failure

1. We did not do it.
2. We did not do it correctly.
3. We did it correctly, but it did not work.

1. **We did not do it**. I have diagnosed time after time where the ration changes never made it to the feeder, and therefore were never fed...amazingly the change did not work.

2. **We did not do it correctly**. Anionic salt technology requires superior management. Herds that do not know what they are feeding for minerals nor what the close-up dry cows eat *have no business feeding anionic salts.* Forages must be analyzed for sulfur, chloride, sodium and potassium. In my experience, chloride and potassium are particularly

variable in the forages grown in the northeast. How can you feed anionic salts correctly if the factors in the DCAD formula are NOT EVEN KNOWN?

3. **The anionic salts did not work.** I think that this is very rare. Anionic salts have been a very consistently performing nutrition management technique in my hands. I can promise a herdsman or manager that the metabolic disease disaster will be changing for the better in a matter of 5-7 days. IF WE DO IT PROPERLY! Urine pH monitoring in the close-up dry cows is a tool to guarantee that we do not commit either of the first two management adoption errors. If the cows get a ration that is correct for DCAD, and enough of that ration, the urine pH values will confirm this. If the forage changes, or if the minerals are not correct, or if too little bunk space is causing poor intakes of the diet, the urine pH will reflect this failure of proper nutrition management. Let's DO IT.

Urine pH Monitoring of Anionic Salt Effectiveness[3]

Average pH	Interpretation
7.0-8.0	Poor Control
6.5-7.0	Maybe Control
6.0-6.5	Control, Holsteins
5.5-6.0	Control, Jerseys
<5.5	Too acid

Weekly urine pH monitoring of close-up dry cows has proven to be a valuable tool in fresh cow management. I recommend simply checking 3-5 cows that have been the close-up group for 48 hours or more with pH paper that has gradations of pH 5.0 to pH 8.0. Occasionally, we need to encourage this by asking to confirm the sample pHs at visit time with my electronic meter. This exercise will add the emphasis that this IS IMPORTANT, and will build confidence in the simple, non-electronic, yet effective pH paper. A fairly well managed herd has the following history of pH monitoring. Usual numbers of cows tested range from 4-8 per week.

Average Urine pH	Feeding management events
7.8	Far-off Minerals fed to Close-up dry cows.
6.1	Freshenings normal. Management happy.
7.6	No minerals fed to Close-up dry cows leads to very poor fresh cow health.
5.9	Freshenings normal. Management happy.

Example Herd: S-V Dairy

This herd had suffered from culling rate of 45-50% of the herd, including about a 10% death loss, for the last 1.5 years. Not on DHI, records were spotty on cow health and production. Herd owners described a death rate of approximately 10% of the herd per year, very poor response to therapies for ketosis, metritis and displaced abomasums. DA incidence was estimated to be 28 of 328 freshenings (8.5%) during the last six months. Owners reported that milk fever was not a problem except during the time when anionic salts were tried in summer of 1995. The only necropsies done on milking cows revealed one "blown lung" and one pneumonia. Severe foot health problems included sole abscesses, sole bruises, white line abscesses, and false soles on many cows during summer and fall of 1995. They were sure the herd was unhealthy because the tank fat test "never is higher than 3.5% when the cows milk well." Recent BST injections had not resulted in any noticeable increase in the tank milk weights. Owners described the dairy herd as being "so sick that they would not even respond to an additional 2-3 pounds of grain per cow per day". They were convinced that stray voltage was causing the whole herd to suffer from foot problems, illness, poor immune response, train-wrecks in first calf heifers, and subsequent poor milk production.

Collected facts and observations on initial visit day:

1. Milk production and % fat and % protein from milk plant - See Figures 16 and 17.
2. CCQ and CCI - See Figure 18.
3. Rumenocentesis - See Figure 19.
4. Body Condition Scoring - See Figure 20.
5. TMR Test Mix yielded results that impressed the husband and wife owners and feeder. Shaking the two TMRs, test mix and mixer mix, yielded *37% fewer particles over 1 inch (shelves 1 & 2) when the ration was mixed in the mixer!* See Figure 21.

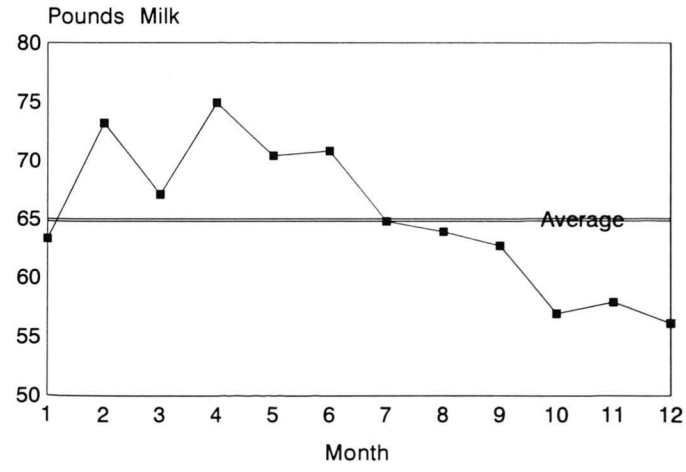

Figure 16. Average Milk Shipped / Milk cow / day S-V Farms: 1995.

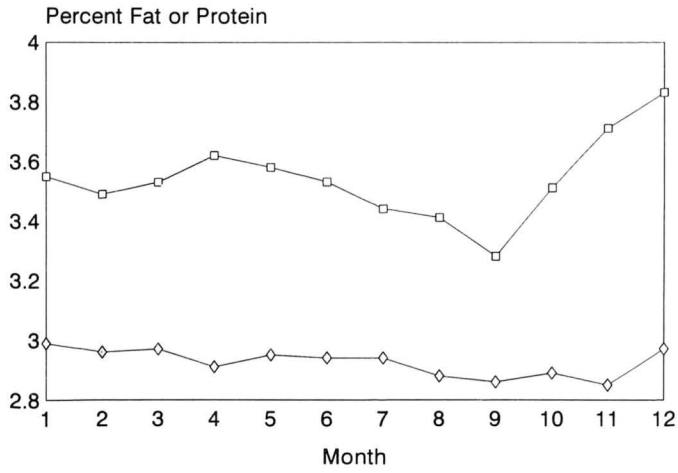

Figure 17. Upstate Milk Coop: Tank Average % Fat, Protein. S-V Farms: 1995.

S - V Farms C CI	
Fresh Group	10/19 = 53%
Group 1	11/61 = 18%
Group 2	24/60 = 60%
Group 3	23/69 = 33%
All Cows	**83/239 = 35%**
CCO	
All Cows	**194/236 = 82%**

Figure 18. S-V Farms

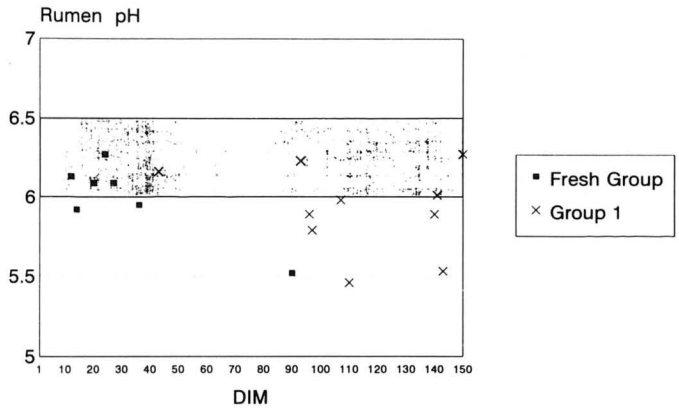

Figure 19. Rumenocentesis Results S-V Farms, 6 February 96.

Investigation into feed cost yielded a $4.65/cwt milk sold for off-farm feed cost for the year 1995. January 1996 showed a feed bill of $4.55/cwt shipped. These dairy owners thought their feed bill was too large at all times, and did not realize that they should have spent around $3.75/cwt...$66,000 less than they had spent. This $ 3.75/cwt was achieved by many of my client dairies in 1995, and is close to the average spent by the most profitable herds on NE Agrifax records. (Figure 3). Examining daily tank weights from June of 1995 showed that the pounds per cow shipped varied by as much as 7 to 8 pounds per day ! Herds suffering from acidosis can cycle on DMI causing the fluctuations in milk shipped.

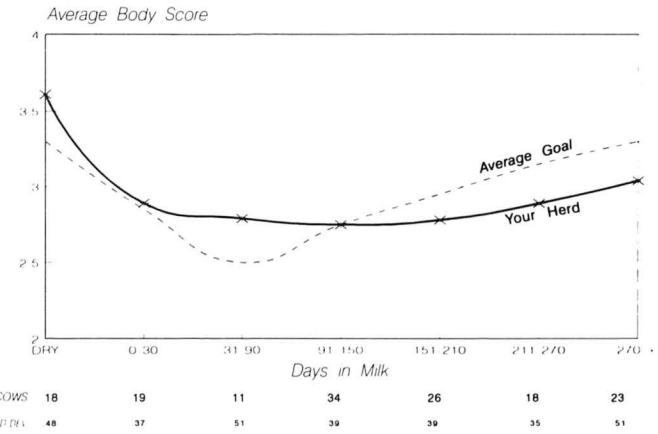

Figure 20. Body Condition Scores by DIM S-V Farms, 6 February 96.

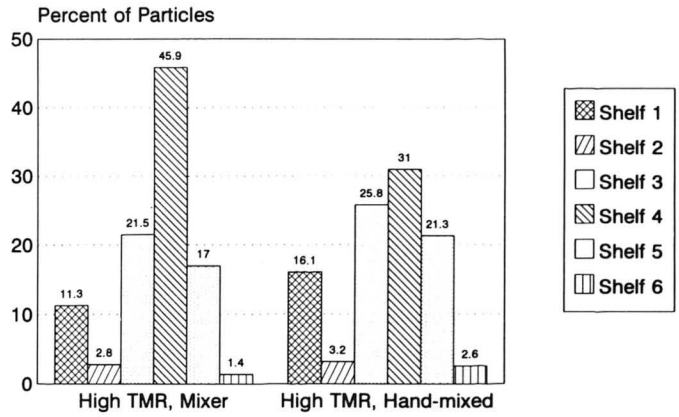

Figure 21. Particle Size Distribution S-V Farm, 8 February 96.

Conclusions and recommendations for this dairy

" Your herd has suffered from acidosis/laminitis for 6-12 months at least. You spent too much on grain, you over-fed your cows, and caused the sickness, poor treatment response, train-wreck heifers, DAs, ketosis, and all the lameness you have struggled with the past year. This herd needs very careful nutrition management and very careful ration balancing to wean it off of too much grain. Many cows will need to be sold because they are not going to return to profitable production. The recent ration changes you have made towards more forage are a step in the right direction, but your mixer is worn out and you are over-mixing your rations prior to delivery.

The cud chewing index and rumen taps today show that your fresh cows are not currently acidotic, but the group 1 cows tend towards moderate rumen acidosis. The hay that you hate to feed has helped the fresh cows and should be fed to all milking groups. Fortunately, you have enough forage inventory to easily feed the required higher forage diets.

Your dry cows and bred heifers are too fat on the average, and should not be fed the 5 pounds of grain mix that they are getting. This is costing you money and probably adding to the current fresh cow problems.

The $66,000 in excess grain purchases for 1995 probably cost you twice to three times that much in reduced production and cow health problems. If you had not spent that money, you could have lost 5.2 pounds of milk per cow per day every day of the year, and you would have broken even. This should help remind you to not feed extra grain to "push the cows."

This will be a very difficult 6-18 months, but you can make this recovery successfully, IF you dedicate yourselves to the task of intensified nutrition management and health and performance monitoring. Other herds have done it, you can too."

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Practical Application of MUN Analyses

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Definition and Origin

Urea is the detoxified form of protein waste in the mammalian body. In the ruminant, excess rumen ammonia is absorbed from the rumen through the rumen wall to the blood stream. It is carried to the liver and is converted into urea by the liver. Urea can be recycled through the blood stream back to the rumen.

The protein waste, ammonia, originates either from the diet or from normal tissue breakdown throughout the cow's body. The high producing milking cow has most of this urea originate from un-used dietary protein. Ropstad, *et.al.*[21] nicely showed the relationship between dietary protein, rumen ammonia, and milk urea in 21 adult and 7 first lactation Norwegian Red cows (Figures 1 and 2). The excess protein can be from any of the protein fractions. We tend to think only of soluble protein, but it can also originate from insoluble degradable, or undegradable protein.[6]

Urea is extremely water soluble and is carried by the blood into all tissues, including the lungs, kidney, rumen, small intestine, uterus and the mammary gland.

Blood and *plasma* and *serum* urea nitrogen (BUN, PUN, SUN) are synonyms for urea levels taken from blood samples. *Milk* urea nitrogen (MUN) measures the level of urea in milk. Until recently, it was believed that milk urea nitrogen levels were about 85-90% of blood urea nitrogen. Very recent work done at the University of Pennsylvania[1] (Figure 3) and Cornell University has demonstrated that milk urea nitrogen is nearly equal to blood urea nitrogen; MUN/BUN = .96-.98. The apparent difference in prior studies was due to improper sample preparation, with milk fat and/or milk