2010 Southeast Dairy Herd Management Conference

November 3 & 4, 2010
Georgia Farm Bureau Building
Macon, GA

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# TABLE OF CONTENTS

Table of Contents .................................................................................................................. 1

Program-Southeast Dairy Herd Management Conference .................................................. 2

Program Participants ............................................................................................................. 4

Contributors and Sponsors ................................................................................................... 5

Program Planning Committee ............................................................................................... 6

**Surviving Low Milk Prices** .............................................................................................. 8
   *Dr. Greg Bethard*

**Improving Herd Reproductive Efficiency** ...................................................................... 14
   *Dr. Ben Shelton*

**An Assessment of Calf Milk Replacer Feeding Programs** ............................................ 18
   *Dr. Al Kertz*

**Surviving Low Milk Prices and a Depressed Economy: Florida Prospective** ............ 32
   *Mr. Ed Henderson*

**A Prospective on Boom and Bust Milk Price Cycles** ..................................................... 36
   *Dr. Joel Riley*

**Dairy Enterprise Debt Payoff and Exit Strategies** .......................................................... 40
   *Mr. Mike Rainey*

**Current Status and Future of the Southern Dairy Industry** .......................................... 50
   *Mr. Calvin Covington*

**What’s New with Waste Management and Environmental Concerns?** ..................... 58
   *Dr. Mark Risse*

**Southeast DHIA Update 2010** ..................................................................................... 64
   *Dr. Dan Webb*

**Control of Contagious Mastitis** ..................................................................................... 68
   *Dr. Ben Shelton*

**Nutrition and Reproduction in Dairy Cattle** ................................................................ 70
   *Dr. José Eduardo P. Santos*

**Nutrition Management, Making Money, and Protecting the Environment** ................ 86
   *Dr. Bob James*

**Calf Rearing Programs that Balance Cost and Value** .................................................. 96
   *Dr. Al Kertz*

**Animal Welfare and NMPF’s Farm Program** ............................................................... 106
   *Dr. Karen Jordan*
Southeast Dairy Herd Management Conference
24th Annual Meeting Program
Wednesday, November 3, 2010

PCDART Workshop
9:30-Noon (Georgia Farm Bureau Building)

First Session
11:00 Conference Registration
Moderator: Dr. Geoff Dahl, University of Florida

1:00 Welcome – Mr. Zippy Duval, President, GA Farm Bureau
Dr. Geoff Dahl, University of Florida

1:15 Surviving Low Milk Prices - Dr. Greg Bethard

2:00 Improving Herd Reproductive Efficiency - Dr. Ben Shelton

2:30 An Assessment of Calf Milk Replacer Feeding Programs – Dr. Al Kertz

3:00 Refreshment Break- Sponsored by Milk Specialties

3:30 Surviving Low Milk Prices and a Depressed Economy: Florida Prospective
- Mr. Ed Henderson

4:00 A Prospective on Boom and Bust Milk Price Cycles - Dr. Joel Riley

4:30 Dairy Enterprise Debt Payoff and Exit Strategies – Mr. Mike Rainey

5:00 Current Status and Future of the Southern Dairy Industry
– Mr. Calvin Covington

5:30 Reception
Second Session

8:00 Conference Registration
Moderator – Dr. Keith Bertrand, University of Georgia

9:00 Welcome - Mr. Zippy Duval, President, GA Farm Bureau and Dr. Keith Bertrand, Professor and Department Head, Animal and Dairy Science Department, University of Georgia

9:15 What’s New with Waste Management and Environmental Concerns? – Dr. Mark Risser

9:45 Southeast DHIA Update 2010 - Dr. Dan Webb

10:15 Control of Contagious Mastitis - Dr. Ben Shelton

10:45 Refreshment Break

11:15 Nutrition and Reproduction in Dairy Cattle - Dr. José Eduardo P. Santos

11:45 Nutrition Management, Making Money, and Protecting the Environmental – Dr. Bob James

12:15 Lunch – Sponsored by Dairy Farmers of America
Moderator – Dr. Warren Gilson, University of Georgia

1:15 Calf Rearing Programs that Balance Cost and Value - Dr. Al Kertz

1:45 Animal Welfare NMPF’s Farm Program – Dr. Karen Jordan

2:15 Questions and Discussion

2:30 Adjourn
Program Participants

Dr. Keith Bertrand  
University of Georgia

Dr. Al Kertz  
ANDHIL LLC

Dr. Greg Bethard  
DRMS, G & R Dairy Consulting, Inc.

Mr. Mike Rainey  
Brian Patch R Dairy

Mr. Calvin Covington  
SMI, Former CEO

Dr. Joel Riley  
Riley Farms LLC

Mr. Ed Henderson  
Shenandoah Dairy

Dr. Mark Risse  
University of Georgia

Dr. Geoff Dahl  
University of Florida

Dr. Jose Santos  
University of Florida

Mr. Zippy Duvall  
President, Georgia Farm Bureau

Dr. Ben Shelton  
Rocky Creek Dairy

Dr. Bob James  
Virginia Tech University

Dr. Dan Webb  
University of Florida

Dr. Karen Jordan  
National Milk Producers Federation


Contributors and Sponsors

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(706) 310-0020

Zinpro Performance Minerals  
Statesboro, Georgia  
(912) 536-2229

Maryland and Virginia Milk Producers  
Reston, Virginia  
(703) 742-6800
Southeast Dairy Herd Management Conference
Program Planning Committee

John Bernard (GA)  
UGA- Tifton

Brent Lawrence (GA)  
Alltech

Adam Burnsed (GA)  
Alltech

Dave McClary (AL)  
Elanco

Jim Chapman (GA)  
Prince-Agri

Steve Nickerson (GA)  
UGA- Athens

Keith Cummin (AL)  
Auburn University

Phil Perry (SC)  
Clemson University

Lane Ely (GA)  
UGA- Athens

Mary Sowerby (FL)  
University of Florida

Jillian Fain (SC)  
Clemson University

Noel Torres (SC)  
Pfizer

Charles Gay (GA)  
Zinpro

Dave Waagner (GA)  
Elanco

Warren Gilson (GA)  
UGA-Athens

Dan Webb (FL)  
University of Florida

Guy Hall (AL)  
Alabama Farmers Federation

Everett Williams (GA)  
Williams Dairy

Tom Jenkins (SC)  
Clemson University
Surviving Low Milk Prices
Greg Bethard, Ph.D.
DRMS Raleigh, NC
G&R Dairy Consulting, Wytheville, VA
greg.bethard@ncsu.edu

During tough economic times it is prudent to evaluate the efficiency of your business. There are many measuring sticks for success, but the most useful during good and bad times is cost per hundredweight generated from accountant summaries. It really doesn’t matter how many pounds of milk your cows produce, or what your cull rate is, provided your economic model results in a low cost per hundredweight. This is a good time to consider key components to making low-cost milk.

Top Ten (Eleven) Keys to Making Money in the Dairy Business
1. Keep a Full Barn
2. Healthy Fresh Cows
3. Offer a Career Change to Unprofitable Cows
4. Realize Quality and Component Premiums
5. Maximize Income Over Feed Cost
6. Minimize Feed Cost/cwt
7. Procure High Quality Forages
8. Generate Pregnancies (Heifer and Cow)
9. Minimize Replacement Costs
10. Cut Costs Intelligently
11. Control Labor Costs

Keep Full Barn. Keeping a full barn means averaging 100% of capacity over a year’s time. Anything less is a lost opportunity, other than the rare circumstance where a marginal cow is not making money. The definition of “full” or “100% capacity” does not necessarily mean one cow per stall or one cow per headlock. It could mean less or more depending on the facility, environment, and management. Every dairy needs to figure out what “full” is for their facility and management, then strive to stay there all year round.

Healthy Fresh Cows. Trickledown economics relating to fresh cows are simple: poor fresh cow health leads to excessive fresh cow culling, poor reproduction, high replacement costs, high cost/cwt, and eventually a dairy in financial trouble. The number one heard health priority should be healthy fresh cows. Healthy fresh cows trump high milking fresh cows.

Offer a Career Change to Unprofitable Cows. Cows that are not covering variable costs need to be traded in for a new cow, or her spot should be left vacant. A breakeven level of production can be calculated to determine if variable costs are covered as follows: (variable costs)/(milk price per pound). Variable costs are those that disappear if one cow is culled. These include feed, bST, chemical/teat dip, interest, and antibiotic risk. If these costs are not covered by the income the cow generates every day, then the cow is not covering her variable costs. For example, suppose variable
costs totaled $5.50 per day and milk is $12/cwt; breakeven level of production is $5.50/$0.12 = 45 lbs. In this case any cow below 45 lbs should be culled. This calculation is independent of the cow being replaced.

Practical uses of this calculation involve adding some common sense to the equation. Pregnant cows (for sure those > 100 days carried calf) on most dairies would not be considered for culling. Cows would need to have two test days below breakeven levels to be considered (some cows may have had a “bad test day”), and the manager or herdsman should visually evaluate before culling to be sure the milk weights are real.

Pregnant cows may be eligible for early dry if it would be less costly to feed her in the dry pen compared to keeping her in the milking string. In this case, breakeven production would be: (variable costs – dry cow feed costs)/(milk price per pound). For example, suppose variable costs are $5.50/day, dry cow feed costs are $2.50, and milk is $12; dry-off level of production is ($5.50 - $2.50)/$0.12 = 25 lbs. In this case any pregnant cow below 25 lbs should be early dried. This logic works to a point – it doesn’t make a lot of sense to early dry a cow with a poor mature equivalent (ME) that is less than 100 days carried calf.

How then is it justifiable to cull poor pregnant cows, or open cows that are poor producers but above breakeven levels? Models have been generated (Eicker et al, Kinsel, 1998, de Vries, 2004) to predict the Net Present Value of a cow relative to a heifer that could take her place. Inputs include value of sold cows, cost of replacement, feed costs, milk price, and risk of pregnancy. A Net Present Value model essentially moves all costs and revenues that are predicted to occur in the future back to present day dollars, making comparison simpler. These models, if followed implicitly, would indicate that any cow with a negative Present Value should be culled. These models are valuable and useful, but can be limited if future economic conditions differ markedly from the present. They are dependent on the cow being replaced.

**Realize Quality and Component Premiums.** Milk premiums in most markets are offered for high quality milk (low bacteria and somatic cell counts), butterfat, and protein. Milk quality is generally the most lucrative, followed by protein then fat. Total premiums can exceed $1.00/cwt on Holstein herds and more on Jersey and crossbred herds. When milk was $20, a $1.00 premium was nice like icing on the cake. Today with $10 milk it is monumental and potentially life-saving for the dairy.

**Maximize Income Over Feed Cost (IOFC).** Income over feed cost is calculated as (milk revenue per cow per day) minus (feed costs per cow per day). If cows are milking 70 lbs, milk is $12/cwt, and feed costs are $5.50/day, then IOFC = (70 * 0.12) – ($5.50) = $2.90. Any change that increases the $2.90 is likely good provided it does not impact cow health.

The IOFC is driven by several factors. Obvious are feed price and milk price. Others include feed conversions, milk per cow, and the value of milk (i.e. components and premiums). Day to day feeding and management decisions should be evaluated using income over feed costs. Feed cost per cwt is a useful tool to gauge the entire feeding program (milking and dry) over a longer period of time, and is impacted by feed buying, shrinkage, waste, and the factors influencing IOFC. Feed cost per cwt is not useful for short term feeding and management decisions; IOFC is more appropriate.
**Minimize Feed Cost/cwt.** Different than IOFC, Feed Cost/cwt is determined from financial statements. It is driven by all the factors that impact IOFC, plus feed shrinkage and dry cows costs. It is simply all feed costs for milking and dry cows (no heifers), divided by hundredweights of milk sold. It is a good “big picture” look at how efficiently your feed dollars are converted to milk.

**Procure High Quality Forages.** The ultimate trickledown economics on a dairy begin and end with forage quality. Cows eating lots of high quality forage under good management will likely be healthy, productive, and fertile. It is quite difficult to have healthy cows with poor forages.

**Generate Pregnancies (Heifer and Cow).** There are many calculations available to determine how valuable a pregnancy is to a dairy. Somewhere around $400 is typical, and in the dairy industry we are well aware of the benefits of getting cows pregnant. Often the importance of heifer pregnancies is forgotten, but they generally make up about 35% of the pregnancies generated on a dairy. They are the easiest to get (particularly in summer), and are equally valuable to cow pregnancies in generating cow flow. The number one reason for culling on most dairies is reproduction (often called low milk). Dairies that need to purchase springing heifers to maintain herd size are really buying pregnancies. It is much cheaper to generate them on the dairy. Pregnancy hard count estimates how many pregnancies a dairy needs to maintain cow flow. Several methods are utilized to compute a hard count. The method described here is simple and relates to cow flow. Assume for this example that a herd has 1000 milking cows (not including dry). This dairy should calve 100 animals per month or 10% of milking cows. Pregnancy Hard Count would be computed as follows:

- **Heifer Calvings**
  - 35% should be heifer calvings, or 35 per month
  - Inflate by 1-2% for abortions or about 36 pregnancies needed per month
  - 36 per month equates to about 25 pregnancies needed per 21 day cycle

- **Cow Calvings**
  - 65% should be cow calvings, or 65 per month
  - Inflate by 15% (or whatever the abortion rate for the dairy is) for abortions or about 75 pregnancies needed per month
  - 75 per month equates to about 52 pregnancies needed per 21 day cycle

The most important question to answer reproductively on a dairy is “are there enough pregnancies being generated?” Pregnancy Hard Count is more useful than pregnancy rate or conception rate in answering this question.

**Minimize Replacement Costs.** Replacement costs are typically the second largest cost of producing milk, behind feed costs. Conceptually, replacement cost is the cost of maintaining herd size and structure. Although genuine dairy accountants have various methods to determine replacement costs, all methods are similar to the following: (value of cows sold - cost of replacement) / cwt milk sold. The value of cows sold is impacted by the kind of cows that are sold (fat, late lactation culls that sell well or beat-up fresh cows that are thin and sell poorly), and the number that are actually sold (deads are generally not sold). The cost of replacement is impacted by what you pay for a new heifer, or the money invested in the home-raised replacement (not including value at birth).
In a situation where all heifers are purchased, the value of heifer calves sold is included in the value of cows sold. Quantity of milk shipped plays greatly impacts the calculation.

Our industry focuses on cull rate as a measure of herd turnover. Replacement cost/cwt, as described above, trumps any other measure of herd turnover. It doesn’t matter what your cull rate is if your replacement costs/cwt are low. It doesn’t matter how much you pay for heifers if your replacement costs/cwt are low. The measuring stick is replacement cost/cwt, and a reasonable goal in most areas of the country is <$1.50/cwt.

Some quick cowboy math illustrates these points. The following three examples are for a herd of 1000 cows with 850 producing saleable milk.

- **Scenario A.** ~70 lbs milk, 40% cull rate, 10% death loss, $500 average cull cow price, and $1200 cost of rearing heifers.
  - Milk sold = 220,000 cwts/year
  - Value of Sold Cows = 300 x $500 = $150,000
  - Cost of Replacements = $1200 x 400 = 480,000
  - Replacement Cost = ($480,000 - $150,000) / (220,000) = $1.50/cwt

- **Scenario B.** ~80 lbs milk, 50% cull rate, 5% death loss, $500 average cull cow price, and $1200 cost of rearing heifers.
  - Milk sold = 250,000 cwts/year
  - Value of Sold Cows = 450 x $500 = $225,000
  - Cost of Replacements = $1200 x 500 = 600,000
  - Replacement Cost = ($600,000 - $225,000) / (250,000) = $1.50/cwt

- **Scenario C.** ~60 lbs milk, 25% cull rate, 2.5% death loss, $500 average cull cow price, and $1200 cost of rearing heifers.
  - Milk sold = 185,000 cwts/year
  - Value of Sold Cows = 225 x $500 = $112,000
  - Cost of Replacements = $1200 x 250 = 300,000
  - Replacement Cost = ($300,000 - $112,000) / (185,000) = $1.02/cwt

Reducing heifer rearing costs is an important factor in lowering replacement costs. Many factors contribute, but paramount is getting heifers pregnant. We often mislead ourselves by using a biased number to evaluate heifer reproduction: conception rate. While a useful number in some ways, the most important number is how many pregnancies are generated over a recent period of time such as a week, 21 day cycle, or month.

**Cut Costs Intelligently.** Cutting costs is necessary and good dairyman can do this intelligently. Cost cutting is OK provided the following areas are not impacted: Forage Quality, Cow Health, Fresh Cows, and Pregnancies. Dairies that cut in these areas are signaling that they do not intend to be in the dairy business long term.
**Control Labor Costs.** There are many measures of labor efficiency. They include cows/employee, and pounds of milk sold/employee. While some of these measures have some utility, the ultimate measure is labor cost per cwt. It really doesn’t matter how many employees you have if labor costs per cwt are “good”. Several issues can skew this number, including contract labor (outside breeding services, outside maintenance services, etc) and if replacements are raised on or off the farm. Ideally only labor involved in taking care of the milking herd should be included. Labor involved with replacements or farming should be considered separate.

**Summary.** Having a low cost/cwt trumps all other rules for making money. Those that make cheap milk will remain in business the longest if they choose.


Eicker, S. Dairy Comp 305, Valley Ag Software, Tulare, CA.
There is no doubt that reproduction in the dairy and beef business is always at the forefront of a producer’s ability to make a profit in their operation. The technology that has been added to our arsenal to aid in pregnancy production has expanded greatly and continues to expand. There are some that remember how it was before prostaglandins were available. Now we have multiple synch programs to manage cow’s ovulation. This enables us to breed cows whether we see them in heat or not. The next challenge then is get the open cows re-bred as soon as possible.

The Bio Pryn blood test detects a Pregnancy Associated Glycoprotein (PAG). The test has been determined to be 99.9% accurate for detecting open cows. It is 95% accurate for detecting pregnant cows. Early embryonic loss is the reason for the potential of a 5% error. For this reason just like any other pregnancy diagnosis it is good to do a recheck. The cow need to be at least 90 days in milk before doing a blood test to detect (PAG) since some residual PAG may still available from a previous pregnancy.

Synchronization protocols can be adapted for use with blood testing for pregnancy. Protocols are also being used for testing Bull-Bred herds.

The following is an explanation of how to use Bio Pryn pregnancy testing in these situations. This information was produced by BioPryn®.
BioPryn blood test detects (PAG) Pregnancy Associated Glycoprotein

99.9 % Accurate for detecting open cows

95% Accurate for detecting pregnant cows

Early Embryonic loss can give a false positive

The cow needs to be 90 D.I.M. before doing a blood test
Shorter calving intervals in the dairy industry leads to more calves, less replacement costs, more lactations over a cow's lifetime, and increased milk yield because the cow spends more of its lifetime in the production phase. However, these gains are not without cost. A shorter calving interval also means less time between calvings, reducing the time available for the cow to recover from calving and to prepare for the next one. This can lead to a situation where the cow is not fully recovered from the previous calving and is not in optimal condition for the next one, potentially leading to decreased milk production and increased veterinary costs.

The cost of these additional treatments is significant, with an estimated $2.59 per day for every day spent exceeding a hundred days postpartum. This estimated increased cost is due to decreased milk production, increased feed cost, plus the costs of additional veterinary and AI services. It is essential to improve management practices to increase the reproductive efficiency of dairy operations. By applying new technologies, such as BioPRYN and OvSynch, producers have observed a decrease in days open and shorter calving intervals. The program works as illustrated in the figure below.

### BioPRYN use in Lactating Dairy Cattle

- **Day 0 (Thursday)** - Day of AI
- **Day 33 (Tuesday)** - Administer GnRH (Cytorelin, Ovaxyst, etc.) Bleed cattle for Pregnancy status using BioPRYN
- **Days 35-37 (Thursday-Monday)** - Receive the report stating pregnancy status from the BioPRYN lab
- **Day 40 (Tuesday)** - Administer PGF2α (Lutalyse, Estrumate, etc.) to all cows determined open by the BioPRYN test
- **Day 42 (Thursday)** - Administer GnRH (Cytorelin, Ovaxyst, etc)
- 8-18 hrs following GnRH administration breed

### Getting cows re enrolled

- **Bleed at 30 DSLH (Tuesday)**
- **GnRH open cows at 32 DSLH (Thursday)**
- **PGF opens cows at 39 DSLH (Thursday)**
- **TIA at 42 DSLH (Sunday)—start over at 0 DSLH**
- Cows are bred on average one week earlier using BioPryn vs. a vet PG checking
- **Bleed all cows 30 days later**
An Assessment of Calf Milk Replacer Feeding Programs

A.F. Kertz, PH.D., Dipl. ACAN
Milk Specialties Global Animal Nutrition
St. Louis, MO
www.andhil.com

INTRODUCTION

“Milk replacers” probably began when whole milk (WM) on the farm was often skimmed off with the fat used to make butter. The skim milk was then a byproduct and often fed to calves or pigs as a MR. This is most likely why earlier fabricated MR from dried ingredients had what is now considered lower fat content. Warner (1960) conducted a trial with 120 Holstein heifer calves purchased at 3 d of age. They were fed 180 lb WM, 25 lb of 2% fat MR, 25 lb of 25% coconut fat MR, and 25 lb of 25% lard oil MR. The amount of WM fed was based on having the same digestible energy as the latter 2 higher fat MR when reconstituted at 0.50 lb per 9 lb water and fed twice daily for 22 d. The average daily gain (ADG) was about 1.0 lb, which was acknowledged as satisfactory gain for herd replacements at that time (Table 1). Author noted that calves on the 2% fat MR also ate more (P<0.05) CS and achieved the same ADG as did the other higher fat MR or WM.

Early Weaning Programs

The 1950s, 1960s, and into the 1970s were a golden age of studies on rumen development in dairy calves (Warner 1991). Program approach then was to minimize the cost and amount of MR fed, and to wean early by encouraging CS intake. An example of this program (Porter et al. 2007, trial conducted in 1972-1973) is where calves were fed a total of 21.4 lb MR reconstituted with water, were abruptly weaned when they consumed an average of 1.5 lb/d CS for 4 to 5 d, and averaged 28 d on trial when fully weaned. Several MR were used and ranged from 22 to 24% CP with 8 to 20% fat (J. C. Porter personal correspondence, June 2009). The ADG before weaning was only 0.35 lb with 0.75 lb daily CS intake, but the study was also done to highlight effects of four CS studied. For 4 wk following weaning, ADG was 1.25 lb with daily CS intake averaging 3.5 lb.

A review of 22 published studies from 1967 to 1977 (Kertz et al. 1979) found an average weaning age of 32 d (range of 19 to 52), average daily dry milk/MR fed of 0.86 lb (range of 0.55 to 1.63), average daily CS intake of 0.66 lb (range of 0.26 to 1.30), only 5 studies fed forage and daily intake averaged 0.2 lb, and ADG averaged 0.66 lb (range of 0.2 to 1.1). This was compared to 5 studies with 18 treatments summarized over a 3-yr period at the authors’ commercial calf research facility. All calves were weaned at an average age of 31 d comprising a 28-d MR feeding period after 3 d of colostrum and transition milk feeding. All calves were fed 0.5 lb dry reconstituted into 2 qt water and fed twice daily for 3 wk followed by only one feeding during the 4th wk before full weaning. Average daily CS intake was 1.0 lb (range of 0.68 to 1.45) while ADG averaged 0.7 kg (range of 0.46 to 1.0). All MR fed contained 22% CP on an as-is dry powder basis while fat content averaged 9.8% as-is dry powder basis with a range of 8 to 15%. Major variable in all of these studies was protein sources in MR. Soy flours, some soy protein concentrates, and some fish protein sources resulted in poorest ADG with accompanying lower CS intake when these protein sources provided one-half of total MR CP. Lower CS intake was similar to impact of poorer quality protein sources seen in monogastrics which often resulted in lower intake and ADG.
Calf trial treatments which resulted in ADG of less than 0.7 lb (average of 0.57), 0.7 to 0.79 lb (average of 0.73), and greater than 0.79 lb (average of 0.9) were associated with average daily CS intakes of 0.88, 1.06, and 1.28 kg. Consequently CS intake representing 65% of the variation in ADG. Calf starter intake represented an increasing proportion of the calf’s total daily nutrition averaging 11, 28, 46, and 76% during wk 1, 2, 3, and 4.

**Fat and Protein Levels in Milk Replacers**

After the 1970s, MR protein levels migrated down from 22 to 20%, and fat levels migrated up from ~10 or 12 % to 20%. This was related more to marketing and controlling feeding costs with the nutritional benefit being higher fat levels increased energy intake of calves from MR. As fat levels increased, that also increased costs, so protein level was decreased to help off-set much of that increased cost. Thus the “industry standard” 20/20 MR evolved. One study (Kuehn et al. 1994) illustrated that an unintended consequence resulted when fat content was increased in MR. A trial was conducted from March through October with 120 calves at three MN locations (two used outdoor hutches). Calves were started on trial at 14 d of age following colostrum for the first 4 d, and then followed by feeding a 21.4% CP and 21.6% fat MR until d 14. No CS was fed during this period. Then calves were fed 20% CP MR on a DM basis with either 15.6 or 21.6% fat, and texturized CS with either 3.7 or 7.3% total fat with the difference in fat coming from inclusion of ground roasted soybeans. Starter and water were available free choice from d 14 to 56 with no forage fed. Before weaning, calves consumed more CS (P<0.01) and gained more body weight (BW, P = 0.04) when fed the lower 15.6% fat MR. There was some carryover effect postweaning as CS intake continued greater (P = 0.04) for the 15.6% fat MR although ADG difference decreased and no longer was significantly different. The reason for this difference in ADG before weaning was evident when metabolizable energy (ME) intakes (Table 2) were calculated. Greater CS intake on the 15.6% fat MR treatment more than compensated for the lower ME MR intake on this treatment. Overall effect was 7 % more ME intake on the low fat MR treatment. This similar level (7%) of higher ME intake continued from CS alone even after calves had been weaned for 14 d. Thus, the higher energy intake from the 21.6% fat MR was more than compensated with lower CS ME intake resulting in less total energy intake compared to a low fat MR treatment. This effect is virtually ignored when high fat MR are recommended. Granted, this study did not cover the coldest weather in MN of November, December, and January. Also, not generally acknowledged, is added value of heat of rumen fermentation from CS in meeting energy requirements during cold weather.

During cold weather there are several options to increase energy intake from MR (Kertz 2008). More MR can be fed, a higher fat level can be used, or a fat supplement can be added to the liquid feeding program. Simply feeding more MR may seem like the best approach, but that means that protein will be overfed since colder weather has little impact on increasing protein requirement (NRC 2001). A higher fat level MR could be used, but that means carrying another product to feed and maybe overfeeding energy, dependent on the weather, age, and CS intake of the calves. The last option of using a fat supplement may provide the greatest flexibility, but still requires some management decisions and practices to implement.
If calves are fed MR longer, more, and with a greater fat content there is a substitution effect with the greater these factors are, the more negatively they will impact CS intake. Greater fat level in the MR reduced CS intake as just noted in the study by Kuehn et al. (1994). When MR contained 12% fat, and calves were weaned at either 4 or 6 wk (Kertz 1987), for each lb more MR consumed from 4 to 6 wk weaning age, CS consumed was 2.0 lb less. But when WM (~28% fat on DM basis) was fed and calves weaned at either 4 or 8 wk (Quigley et al., 1985), amount of CS consumed was 3.6 lb less. Thus, there is a considerable range in amount of energy from milk/MR fed and its impact on CS intake.

A confounding factor in consumption of CS is the availability of clean water. Calves consume four times more water than DMI from CS (Kertz et al. 1984). This ratio before weaning is lower at 2 to 1 when also considering water mixed with MR, but then this ratio quickly elevates to 4 to 1 after weaning (Quigley et al. 2006). This ratio of 4 to 1 water/DMI may well continue after the calf period as a recent study showed a similar relationship in lactating dairy cows (Kramer et al. 2009).

**Milk Replacer Feeding Scenarios**

There are a variety of liquid feeding programs used by dairies in the U.S. (NAHMS 2007). Larger herds use more nonmedicated MR, more pasteurized waste milk, and less unpasteurized saleable milk than smaller herds (Table 3). But it also is evident that many dairies use a combination of liquid feeds for their calves as the last column sums to 136%. How can such programs be evaluated? It depends on how complete and accurate input information is.

The 2001 National Research Council (NRC) Nutrient Requirements for Dairy Cattle Young Calf Model was utilized to illustrate how MR feeding programs would provide for energy allowable daily gain (EDG) and protein allowable daily gain (PDG). A zone of thermal neutrality temperature of 68°F was used, and both EDG and PDG plotted for respective BW shown. Intervals of 10 lb BW were used to illustrate typical BW that would be experienced by Holstein calves in their first several mo of life.

Using a 20/20 MR fed at 0.5 lb mixed into 2 qt water and fed twice daily (Figure 1), there is only enough CP and energy for just over 0.5 lb ADG when a calf weighs 95 lb. As a calf increases in BW, and maintenance energy requirements increase, EDG rapidly decreases while PDG decreases much less rapidly. Thus, more MR is needed for an increased ADG with increasing BW. If the 20/20 MR were fed at 1.5 lb divided into twice daily feedings, amount of water/MR fed as a liquid must be increased to 3 qt twice daily in order to maintain the same ~12.5% solids. If not done, osmolality would be unduly increased which could lead to some degree of digestive upset, and possibly predispose to a clostridia problem. Currently, many have increased the typical 0.5 lb feeding rate to 1.25 lb MR in 4 qt divided into twice daily feedings. That provides approximately 15% solids, the practical upper limit MR feeding level noted.

Increasing MR feeding rate to 1.5 lb/day vs 1 lb/day resulted (Figure 2) in doubling ADG to greater than 1 lb initially, EDG being greater than PDG initially, and then much less of a decrease of EDG which is now more closely matched to PDG. But this also required 3 qt per MR feeding in order not to exceed the 15% solids mixing rate.
Figures 1 and 2 only considered effect of MR feeding, not effect of CS. Starter intake is influenced by a number of factors: nature and quality of the starter, level of MR feeding, fat level of MR (Kuehn et al., 1994), water cleanliness and availability, and combinations of these factors. Using assumed CS intakes which would approximately double each wk, intakes used were 0.125 lb/d during wk 3, 0.25 lb/d during wk 4, 0.5 lb/d during wk 5, 1 lb/d during wk 6, 2 lb/d during wk 7 when one feeding of MR was eliminated, and 4 lb/d during wk 8 after calves were fully weaned. This assumed pattern is likely high for MR feeding levels above 1 lb/d. Adding these assumed CS intakes to Figure 2 resulted in Figure 3. Daily gain due to the additive effect of MR and CS would have been above 1 lb/d starting at 125 lb BW; and during 145 lb BW wk, would have been nearly 1.5 lb. During once daily MR feeding wk, ADG would have decreased to about 1 lb/d until the following 165 lb BW wk when CS intake would have doubled to 4 lb/d. This increased ADG, to the target range of 1.8 to 2.0 lb/d, is the goal for the entire post-weaning period for heifers up until first-calving.

Advent of Accelerated Milk Replacer Feeding and Related Research Trials
In 2001, Tikofsky et al. published a study in which Holstein bull calves were fed a constant energy and protein level from MR which differed in having either 15, 21, or 32% fat. Intakes were adjusted weekly resulting in a similar daily empty BW gain of 1.36 lb. Body composition data are plotted on a moisture-free basis (Figure 4) because there is an inverse relationship between body fat and water. Fat content of empty BW was greater (P<0.006) for 32% vs 21% fat, and for 21 vs 15% fat. Fat content of empty BW, without correction for moisture content, was 8.5% for 15% MR, 9.9% for 21% fat MR, and 11.5% for 32% fat MR. Since ADG were the same across treatments, Figure 4 shows that body fat progressively increased with % fat in MR, while both % CP and ash in empty BW proportionately decreased. Thus 15% fat became the optimum level in accelerated MR programs.

Subsequent studies (Diaz et al. 2001; Blome et al. 2003; Brown et al. 2005; Bartlett et al. 2006, and Davis-Rincker et al. 2010) indicated that accelerated (also termed biologically normal, enhanced, or intensive, i.e. greater than typical traditional MR feeding programs) programs had beneficial results on ADG and composition of BW gain.

Accelerated Feeding Programs
Questions as to how accelerated MR feeding programs perform in relation to interaction between MR feeding level and CS intake, ADG, and weaning transition were addressed in several studies (Stamey 2008). In the first study (Stamey et al. 2010a), Holstein female and male calves were fed either a conventional 20/20 MR with 12.5% solids at 10% of birth weight daily in two feedings from wk 1 to 5 and at 5% once daily during wk 6; or 28/15 MR with 15% solids at 1.5% of BW as DM during wk 1, 2% of BW as DM during wk 2 to 5 divided into two daily feedings, and at 5% of birth weight during wk 6 in one daily feeding. All calves were weaned at end of 6 wk. The 28/15 MR feeding program contained two CS treatments of 18 or 22% CP as-is DM or 19.6 and 25.5% CP DM basis; which were combined into one dataset for the graphing comparison (Figure 5) since there were no significant differences between the two starter treatments (a corollary study was done with bull calves which also found no difference between the same 18 and 22% CP starters—Stamey et al. 2010a). Lower 20/20 MR feeding (P < 0.01) resulted in greater CS intake (P < 0.02) but less ADG and height increase (P < 0.02) than 28/15 treatments during preweaning. Total MR intakes were 42.5 for 20/20 and 76.4 lb for 28/15 with CS DMI before weaning were 31 and 16 lb, respectively, with another 56 lb DMI during their two wk after weaning. With greater DMI from MR, lower CS DMI resulted on 28/15 MR. But total nutrient intake was greater on 28/15 resulting in greater (Figure 6)
ADG except for wk 7 which was just after full weaning. Figure 5 shows that loss in 28/15 MR DMI with full weaning was not equalized by CS DMI vs 20/20 MR treatment during wk 7, but it was in wk 8-10 when ADG was similar between MR treatments.

The second study (Stamey et al. 2010b) compared a 20/20 MR feeding program (conventional--CON) with an 18% CP CS to a 26/18 higher level MR feeding program (moderate--MOD) with a 20% CP CS, and to a 28/20 highest level MR feeding program (aggressive--AGR) with a 22% CP CS. Each MR was fed at different levels, but all calves were weaned at the end of 6 wk of age, and kept in individual hutches until the end of 9 wk of age. After that they were group-fed in super hutches until 12 wk of age. As MR feeding level increased to 34.8, 69.1, and 84.1 lb for treatments, respectively, CS intake preweaning decreased inversely to MR intake at 93, 44, and 25 lb (Figure 7). This CS intake pattern continued to a lesser extent postweaning during wk 7-9. Preweaning ADG followed pattern of daily MR intake at 0.95, 1.2, and 1.4 lb, respectively. Postweaning ADG was 2.2, 2.4, and 1.8 lb, respectively, with AGR 28/20 MR treatment being lower than the MOD 26/18 MR treatment. The MOD 26/18 MR treatment carried over its intermediate ADG preweaning into intermediate CS intake, but with highest ADG of 2.4 lb postweaning. This reflects that the AGR 28/20 MR treatment calves gained more preweaning due to greatest MR consumed, but the lowest CS intake preweaning carried over into the lowest CS intake postweaning for this treatment. The MOD 26/18 MR treatment had the best overall scenario among these treatments. In particular, Figure 8 shows that while AGR 28/20 MR had the best ADG for the first 4 wk, that ADG decreased the most during wk 6 of one-half MR feeding, and did not catch up until wk 9. Lower CS intake on this treatment would have been related to higher MR fat level and greatest level of feeding of MR among treatments. In a study with a 26/17 MR fed at or above 1.5 lb/d, Hill et al., (2007a) found that CS was decreased while ADG was similar except during the first wk when it was lower at the 0.681 kg/d feeding rate. When both 26/17 and 28/20 MR were fed at a high daily rate of 1.96 lb/d, ADG were similar by weaning with no differences in CS intake.

The 2001 Dairy NRC Young Calf Model, which provided a basis for energy and protein requirements of calves, has since been updated (Van Amburgh and Drackley, 2005) based on studies by Diaz et al. 2001, Tikofsky et al. 2001, Blome et al. 2003, and Bartlett et al. 2006 at Cornell-Illinois, Table 4). For calves to grow faster, they either need to be fed more milk, MR, or consume more CS if they were older calves, and requirements needed to be adjusted if calves are outside the zone of thermal neutrality. The 2001 NRC uses 59 to 77 °F for this zone for calves less than 21 d of age. Cold weather has the most impact on increased maintenance energy requirements although heat stress can also increase requirements which have not yet been well quantified.

Some key comments about this table’s requirements are that amount of milk solids required to meet maintenance requirements is sizeable, about 1.75 Mcal/d for a 100 lb calf (Drackley 2010). Whole milk has about 2.4 ME ME/lb of solids. Hence a 100 lb calf requires about 0.70 lb milk solids or 5.6 lb of whole milk (~2.3 qt) just for maintenance. Milk replacers are lower in fat than whole milk so 0.84 lb of MR (2.1 Mcal/lb) would be required for the 100 lb calf to meet its maintenance requirements. Comparing WM to MR depends on what objectives are with a liquid feeding program, and preferences.
For calves to grow faster, they need to be fed more milk or MR. As calves get bigger and older they can and should be eating more CS, but the substitution factor will be somewhat limiting because of the inverse relationship between amount of milk/MR fed/consumed and resultant CS intake. But that depends on how well the CS is integrated into the calf program, such as amount of milk/MR fed, its fat/energy level, when CS is initially fed and how much at the early stages of intake, physical form and fines level of starter, and how well water is being made available. An offsetting factor leading to greater CS intake is that as calves get larger, their need and impetus to eat more also increases with increasing BW.

The CP % of diet DM in Table 4 is based on the sum of both milk/MR and calf starter CP contributions. If realistic values are used for both liquid and CS intakes, the Young Calf Model will not show CP as % of DM for the CS to be greater than 18 to 20%, which is 16 to 18% CP for the CS on an as-fed basis. In four trials (Hill et al. 2007b), CP in CS greater than 18% as-is DM basis did not increase intake, ADG, or other parameters measured, and when fed 20/20 MR at 1 lb/d or 26/17 MR at 1.5 lb/d

**Long Term Effects on Milk Production**

While potential benefits of accelerated MR feeding were originally postulated as being due to reduced age at first calving (AFC), recent analyses by Soberon et al. (2010) indicated benefits may accrue to subsequent milk yield. A Test Day Model (TDM) was developed utilizing inputs of preweaning ADG, birth weight, weaning weight, calving age, birth year, birth month, and calculated energy intake over estimated maintenance requirements. For every additional 1 lb of ADG (within the range of 0.29 to 2.7 lb/d), 792 heifers produced 1,067 lb more milk during their first lactation (P<0.01) and continued to produce more during their second and third lactations. Preweaning ADG accounted for 25% of variation in first lactation milk yield. Age at first calving did not affect milk production within a range of 20 to 30 mo. Colder weather for calves negatively affected subsequent milk production as less energy was available over increased maintenance needs for young calves resulting in their lower growth rate. Probable mechanisms for this increased milk yield are not understood, but are speculated to be related to very early mammary gland development. Drackley (2010) found an additional 10 studies which measured subsequent first lactation milk production as related to pre-weaning performance. All but one of those studies had positive effects on subsequent milk production.

**Implications**

Early weaning programs emphasized limited MR feeding in order to limit feed costs, to increase CS intake, and to stimulate rumen development. When accelerated MR feeding programs were initiated, they emphasized feeding more MR and with a higher CP level to increase ADG more nearly to a calf’s ability to grow without excessive fattening. The optimal MR fat level was 15%. Benefit from accelerated MR feeding programs was postulated to decrease age at first calving by one or more months. But most recent data indicate the primary benefit appears to be additional milk yield in first and subsequent lactations related to ADG before weaning. When an additional lb ADG prior to weaning results in 1,000 lb more milk in the first lactation, this benefit would have the greatest economic return.
LITERATURE CITED


Table 1. Daily gain and calf starter intake for calves fed several milk diets up to 7 wk of age (Warner, 1960).

<table>
<thead>
<tr>
<th>Diet</th>
<th>No. calves</th>
<th>ADG, lb</th>
<th>Starter intake, kg/d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole milk</td>
<td>30</td>
<td>1.08</td>
<td>78.0a</td>
</tr>
<tr>
<td>2% fat replacer</td>
<td>30</td>
<td>1.06</td>
<td>87.4b</td>
</tr>
<tr>
<td>25% coconut fat replacer</td>
<td>30</td>
<td>1.03</td>
<td>78.6c</td>
</tr>
<tr>
<td>25% lard oil replacer</td>
<td>30</td>
<td>.95</td>
<td>75.3a</td>
</tr>
</tbody>
</table>

ab P<0.05 Means in columns differ if superscripts differ among means.

Table 2. Calculated total Mcal metabolizable energy (ME) intakes and daily gains from treatments differing in milk replacer fat level (Kuehn et al., 1994).

<table>
<thead>
<tr>
<th>ME Intake, Mcal</th>
<th>15.6% fat</th>
<th>21.6% fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>d 14-42</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk replacer</td>
<td>43.7</td>
<td>48.0</td>
</tr>
<tr>
<td>Starter</td>
<td>52.2</td>
<td>41.9</td>
</tr>
<tr>
<td>Total</td>
<td>95.9</td>
<td>89.9</td>
</tr>
<tr>
<td>Daily gain, lb</td>
<td>1.10a</td>
<td>0.95c</td>
</tr>
<tr>
<td>d 42-56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Starter</td>
<td>73.7</td>
<td>69.2</td>
</tr>
<tr>
<td>Daily gain, lb</td>
<td>2.09</td>
<td>2.05</td>
</tr>
</tbody>
</table>

P<0.05 Means with different superscripts within rows differ.

Table 3. Liquid feeding programs as a percentage of all operations by herd size (NAHMS 2007).

<table>
<thead>
<tr>
<th>Dairy size, cows</th>
<th>Small &lt;100</th>
<th>Medium 100-499</th>
<th>Large 500 or &gt;</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonmedicated milk replacer</td>
<td>11.4</td>
<td>14.2</td>
<td>26.4</td>
<td>12.7</td>
</tr>
<tr>
<td>Medicated milk replacer</td>
<td>55.2</td>
<td>68.2</td>
<td>43.6</td>
<td>57.5</td>
</tr>
<tr>
<td>Unpasteurized waste milk</td>
<td>32.2</td>
<td>25.7</td>
<td>27.6</td>
<td>30.6</td>
</tr>
<tr>
<td>Pasteurized waste milk</td>
<td>1.0</td>
<td>3.0</td>
<td>28.7</td>
<td>2.8</td>
</tr>
<tr>
<td>Unpasteurized saleable milk</td>
<td>32.2</td>
<td>17.4</td>
<td>12.1</td>
<td>28.0</td>
</tr>
<tr>
<td>Pasteurized saleable milk</td>
<td>1.3</td>
<td>1.6</td>
<td>2.0</td>
<td>1.4</td>
</tr>
<tr>
<td>Other</td>
<td>2.6</td>
<td>3.5</td>
<td>4.9</td>
<td>2.9</td>
</tr>
</tbody>
</table>

Table 4. Nutrient requirements and estimated gain:feed for a 110 lb calf under thermal neutral conditions, using the Cornell-Illinois modification of NRC (2001) equations (Van Amburgh and Drackley, 2005).

<table>
<thead>
<tr>
<th>ADG lb/d</th>
<th>DMI % of BW</th>
<th>ME Mcal/d</th>
<th>CP g/d</th>
<th>CP % of diet DM</th>
<th>Estimated gain:feed</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.44</td>
<td>1.05</td>
<td>2.34</td>
<td>94</td>
<td>18.0</td>
<td>0.38</td>
</tr>
<tr>
<td>0.88</td>
<td>1.30</td>
<td>2.89</td>
<td>150</td>
<td>22.4</td>
<td>0.63</td>
</tr>
<tr>
<td>1.32</td>
<td>1.57</td>
<td>3.49</td>
<td>207</td>
<td>26.6</td>
<td>0.77</td>
</tr>
<tr>
<td>1.76</td>
<td>1.84</td>
<td>4.40</td>
<td>253</td>
<td>27.4</td>
<td>0.86</td>
</tr>
<tr>
<td>2.20</td>
<td>2.30</td>
<td>4.80</td>
<td>318</td>
<td>28.6</td>
<td>0.87</td>
</tr>
</tbody>
</table>
Figure 1. Predicted PDG and EDG using the NRC 2001 Young Calf Model and a milk replacer (MR) feeding program of 0.227 kg 20% CP and 20% fat MR mixed into 1.89 l water and fed twice daily.

![Graph showing Predicted PDG and EDG using the NRC 2001 Young Calf Model and a milk replacer (MR) feeding program of 0.227 kg 20% CP and 20% fat MR mixed into 1.89 l water and fed twice daily.](image1)

Figure 2. Predicted PDG and EDG using the NRC 2001 Young Calf Model and a milk replacer (MR) feeding program of 0.34 kg 20% CP and 20% fat MR mixed into 2.84 l water and fed twice daily.

![Graph showing Predicted PDG and EDG using the NRC 2001 Young Calf Model and a milk replacer (MR) feeding program of 0.34 kg 20% CP and 20% fat MR mixed into 2.84 l water and fed twice daily.](image2)
Figure 3. Predicted ADG from milk replacer (MR) protein and energy provided and from starter (ST) protein and energy provided for a 20% protein and 20% fat MR fed at 0.32 kg in 2.84 l water twice daily until only one-half of that was fed for a wk followed by full weaning. The weaning transition period is the two wk before and two wk after weaning. The post weaning ADG goal is 0.8 to 0.9kg.

![Graph showing ADG from milk replacer (MR) protein and energy provided and from starter (ST) protein and energy provided.]

Figure 4. Moisture-free empty BW CP, fat, and ash proportions in calves fed milk replacers differing in % fat (Tikofsky et al. 2001).

![Graph showing moisture-free empty BW CP, fat, and ash proportions in calves fed milk replacers differing in % fat.]

28
**Figure 5.** Milk replacer (MR) 20% CP/20% fat and 28% CP/15% fat DMI and starter (ST) DMI for MR treatments (Stamey et al. 2010a).

![Graph showing DMI kg/d](image1)

**Figure 6.** Average daily gain (ADG) weekly for 20% CP/20% and 28% CP/15% fat milk replacers (MR) over pre- and post-weaning periods (Stamey et al. 2010b).

![Graph showing ADG kg/day](image2)
Figure 7. Dry matter intakes (DMI) of protein/fat % milk replacer (MR) treatments and of accompanying starter (ST) treatments (Stamey et al. 2010b).

Figure 8. Average daily gain (ADG) with milk replacer (MR) treatments of protein/fat % during 9 wk with full weaning at the end of 6 wk (Stamey et al. 2010).
Surviving Low Milk Prices and a Depressed Economy: Florida Prospective

Mr. Ed Henderson  
Shenandoah Dairy  
Live Oak, FL  
ejh99@windstream.net

Although we are still recovering from last year’s depressed economy, now is the time to begin preparing for the next down turn. If you wait until you’re in the middle of the depression to prepare, you’re too late. With that being said, I sure wish I had done a better job of preparing. As a farmer, we have all contracted a huge dose of optimism and 20/20 hind sight. After all, if you’re going to farm, you better be an optimist.

As a business man, I think that I should always operate my business as efficiently as possible no matter the milk price. But the truth is, there is always room for more belt tightening…like it or not. As milk price increases, so does our appetite for risk. As milk prices decrease, the conservative “mind set” must step in. As milk prices plunge, our “mind set” must recoil to only the basic spending features that we know to be tried and true. Surviving low milk prices means that real devotion to details must take place. High milk prices allow a certain degree of apathy regarding execution. However, when the tide turns, the pace must be focused.

At our farm, the centerpiece is communication. When the economy tightens, the last thing you need is your brother, or your wife, or whoever your business partner is, left in the dark regarding what the balance is or what it is going to be in the checkbook. It is never any fun discussing the bad news. But the news only gets worse if not communicated upfront. The financial institution should be well aware of the economic condition well prior to any year-end statement. Surprises in the checkbook only lead to confrontation and that is devastating to the second item. The second item is, “what is our plan.” Then execute that plan. We had a good plan. The milk prices sure messed up a good plan. We had to modify our plan. Communicate the new plan and execute. Obviously, the plan had to offer cuts in spending. But the modification process had to bring all the ideas together in order to get the best options on the table. Everyone is a part of the process.

Executing the plan is essential. With everyone on board and everyone well aware of the stakes, then the plan has a much greater chance of success. The details ultimately measure the success of the plan. Even with low milk prices, we had successes.

The success of our plan came in meeting our short term goal, increasing cows milked. In 2008 we had installed an automated ID system. The original plan of the system was to more effectively care and monitor our cows. We came to realize that the system did a good job of measuring milking technician performance. But the greatest value came with controlling the milking duration. Cows are an incredible creature of habit. The automated milk recording system allowed us to limit or time the amount of time it took to milk a cow. We trained the cows slowly by controlling the take-off to 8 minutes, then 7.5, and continued down to the current 6.9 minute limitation. The key was training the technicians to treat every cow the same. The system allowed us to monitor, measure, and execute the routines.
Effectively, we were able to increase cow numbers over 10%. This was a dramatic benefit to helping compensate the low milk prices. We moved from a peak cows milked of 2350 to over 2600. We were further able to accomplish the task through internal growth. Our heifer program is growing 5 to 7 percent per year. We controlled culling and the outcome put us over the 2600 cows milking target. Focus on small victories. It takes a lot of baby steps to get to the finish line. We typically set small achievable goals that we celebrate with pizza or chicken wings. For instance, three milkings in a row over 60,000 pounds, or one week no dead cows, or 100 acres harvested on a particular day. We simply post a notice what the goal is. Then post chicken wings on Friday. It’s not a big deal. But the recognition is substantial. Plus it allows everybody to focus on a specific item.

Essentially our only means of survival are to increase revenues and limit expenses. That is with any business. The dairy business however limits means of increasing revenue to only shipping more milk. Thereby, we are all in the category of “survival of the fittest.” We become our own worst enemies! I survive by shipping more milk whereby I contribute to the very problem that got us here in the first place, low milk prices. But, my topic is surviving low milk prices, not solving low milk prices.

The focus of our business is to be as efficient as possible...always. When you are faced with extreme economic conditions, you will have to improve on that. Essentially, our business model:

1. Have a business plan.
   - An economic road map for the business.
   - Reviewed monthly via comparisons of actual to budget.
2. Communicate
   - It is essential that all business partners are clear about the condition of the business.
   - No surprises. The yearend statement is understood by partners and bankers well before presentation.
3. Modify the plan.
   - We are not a publicly traded company. We can modify our plan as needed. The dairy industry does not give us a predictable forecast for milk prices. Therefore, any roadmap created in November will need adjustments by June only because the predictions were so unpredictable.
   - Don’t forget item 2.
4. Execute the plan.
   - Details.
   - Celebrate the small victories.

Beyond the cost cutting, focus on detail, and business plan modifications, it was impossible to recoup the losses from the plunging milk prices. We found substantial relief in our business by spending time on long range planning. We worked on 5 and 10 year planning. It allowed us to put a different light on our current economic condition. It allowed us to spend time on the positive aspects of business. Focusing only on the near-term the last 18 months can lead to some depressing attitudes. By bringing long range planning into the picture, a positive light was allowed to cast on our business planning.
We spent time on our 100 year business plan…preparing for the next generation. How will we encourage our next generation to be a part of our heritage? We have come up with this plan for our children:

1. At 15 years old, they may be allowed to purchase shares of the business. This helps educate them about business. They can attend our business meetings. We have to teach them how to read financial statements. Plus this allows them to more fully understand what opportunities are realistically available to them after graduation from college, HS, or other tech school.
2. They are encouraged to participate in jobs in multiple departments.
3. We will pay a portion of their college expenses in exchange for working on the farm (like the Army).
4. Upon returning to the farm, they must work through at least three departments.
5. They can enter full-time employment & supervisor level only through the hiring process.
6. In order to achieve a management position, they must present a business plan to the board regarding a process to improve the business or create a new business. The plan is to be presented to the board. The only means to a management position is through approval of the board.

The whole process is to establish a road map on what the expectations are. We want to encourage the next generation. But it cannot be handed to them. It has to be earned.

This business planning was not the result of low milk prices. However, doing this planning allowed a great distraction from otherwise very dismal economic conditions. Keeping a positive outlook is vital to surviving low milk prices.
A Prospective on Boom and Bust Milk Price Cycles

Joel Riley, DVM
Riley Farms, LLC
Saluda, SC
(864) 941-7442

No one involved in the dairy business has to be told the present depressed economic cycle has been longer with greater loss of farm equity than previous ones. We all are hopeful we have seen the bottom of this cycle and better times are ahead.

During times of economic down cycles the dairy farmer who remains progressive and efficient will survive. However, it is not the producer who is profitable during boom cycles and sets aside the bust cycle who will survive. It is the producer who during bust cycles is able to position themselves to take full advantage of the next boom. Hard work, efficiency, attention to detail and progressive thinking are more important now than ever.

Our philosophy for handling these boom and bust cycles has been to adopt any management and feeding practices that can show a positive income over cost to increase milk production. During boom cycles we have constructed facility improvements and replaced needed equipment for labor efficiency and cow comfort. Bust cycles are weathered by limiting expenses but never sacrificing milk production.

For 60 years Riley Farms, LLC has been a family operated dairy striving for optimal production. Beginning with mixed breeds and Jerseys in 1949, converting to grade and registered Holsteins in the 1960s and is now a 100% homebred registered herd of 140 cows. Today the herd is milked three times a day, in a double eight herringbone parlor constructed in 2000. Milking system updates were made in the fall of 2007 and consist of new Surge-Westfalia arm take-offs, inline milk meters, electronic cow id-pedometers. Cows are housed in a 120 stall sand bedded free stall barn with head locks, built in the summer of 2002. Thermostat controlled 52” fans are located over free stalls and timer controlled soakers are located over the feed line headlocks. Alleys are flushed twice daily and in good weather cows have access to dirt lots at night. Silage of corn and rye grass is grown and stored in three concrete waste blocked lined pits. Dry purchased feed of ground corn-soybean meal blend, dried distillers, grain, soy hulls, citrus pulp, whole cotton seed, and mineral premix is stored in a divided bay shed also constructed in 2000.

We concentrate our management in the following five areas:

1) Cow Comfort

   A. Reducing Heat Stress

   - Heat abatement
   - Fans over free stalls
   - Soakers over feed line
   - Fans and soakers in holding pen
Data from Israel shows an expected 5%-10% improvement in yearly milk production with feed efficiency improvement during heat stress. See Hoards Dairyman, July 2010 issue, page 485.

B. Sand Bedded Free Stalls

- Clean and dry
- Manure raked out at each milking
- Clean sand added once weekly
- 48” wide and 72” long
- Unobstructed lunge space

C. Alleys

- Flushed twice daily
- Less manure tracked to the stall
- Greater foot traction in alleys (no manure film)

D. Disease Prevention

Observe the basic principles of disease prevention by reducing stress to a minimum; preventing exposure to pathogens to lowest level possible; promoting highest level of immunity through proper nutrition and strategic immunization.

Investment in cow comfort pays in all economic climates through decreased SCC (increased milk production and milk plant premiums), reproductive efficiency, reduced disease morbidity and mortality.

2) Quality Forages

A. Harvest for quality not quantity

- Dry matter intake can be and usually is limited by rumen fill
- Grasses harvested at boot stage are less will be higher in protein with greater digestible NDF
- Greater persistency of lactation with high forage diets

B. TMR Additives That Promote Greater Feed Efficiency

- Rumensin
- Cinagar (Vigortone)
- Direct Feed Microbial
  - Digestamax (Vigortone)
  - Tri-mic (Accelerated Genetics)
Intentionally replacing high quality feed ingredients for lower cost ingredients during periods of economic stress does not pay because short-term production loss versus cost saving may not even pencil out but long-term production will suffer.

3) Genetics

- Proven bulls 90th percentile net merit
- Genomic bulls 99th percentile net merit
- Udder composite and feet leg composite >1.5 proven and >2.0 genomic
- SCS <3
- Productive life >3
- Calving ease 8 or less
- Breeding season
  - Heifer mid-November
  - Heifers bred as soon as 13 months (800 lbs)
  - Lactating cows December 1st
  - Peak milk-summit milk higher when calving in cooler weather with less death loss

Genetic value of semen used today is half the genes of cows you will milk three years from now.

4) Calf Raising

- Newborn immunity
- Dam receives guardian at dry-off
- E. Coli anti-serum (Bovine Ecolizer – 30 minutes to 1 hour after birth)
- Colostrum replacer at birth (Colostrix 130)
- At five weeks – MLV - IBR - BVD - PI3 - BRSV and Lepto
- At six weeks – dehorned
- At seven to eight weeks – weaned
- At four to six months – MLV and Clostridials
- At twelve months to one month prior to breeding – MLV and Clostridials

Dead calves do not produce milk in two years; poor doing calves under perform in two years; well grown calves cost more to raise but perform at or above expectations in two years.

5) Employees

- Trained well and supervised
- Demand gentle cow handling
- Pay bonuses for milk plant SCC premium

A poorly trained, unmotivated or unhappy employee can cost an operation more in one day than their annual salary.
The purpose of this presentation is not to encourage the exiting of the dairy business; however, everyone needs an exit strategy whether they have one or not. Because exiting will be the last thing you actually do from the standpoint of your business, it keeps getting pushed off into the future. Everyone exits their business at some point either by design or by default. If you are proactive, you can have input into the process rather than let someone else determine the fate of your assets. When you started in this business, you probably spent time planning, sought professional advice, and involved your family in the process. You should go through this same process as you exit. It will take some time to dismantle a business that has been put together and grown for 3 or 4 decades or maybe several generations. Most likely, if you have grown your business over the years, you probably have a good bit of equity, but you may actually owe more now than when you got started. One of the biggest hurdles will be mentally preparing for the emotional and financial decisions. There will be lots of decisions to make, and some will be between “bad” and “not so bad”.

An “exit” discussion starts with an honest evaluation of where you are at present and where you are headed in the future. This talk is not a way out, but intended to give you things to consider and hopefully move this process up your priority list. You are not too young right now to develop a plan for your exit, but this does not mean that you have to execute it until the timing is right.

Exit strategies from the dairy business are discussed in the following PowerPoint presentation.
Exit Strategies

Why is this topic on the agenda for this conference?

- Because everyone exits their business at some point in time - either by design or by default.
Exit Strategies

• An “exit” discussion starts with an **honest** evaluation of where you are and where you are headed.

---

**Why the need for planning your exit?**

a. To minimize the stress associated with this transition in your life

b. Prepare for cash flow issues related to tax liabilities, debt repayment, etc.

c. Prepare for the investment of net proceeds from sale of assets

d. Prepare for loss of income and its replacement

e. Prepare for the change in lifestyle
Exit Strategies

What are reasons you might exit?
a. Death
b. Declining health
c. Labor related issues
d. Economic issues
e. Market conditions
f. Age or physical limitations
g. Aging facilities
h. Compliance or regulatory issues
   - Environmental
   - Milk quality
   - Business
i. A combination of any of the above

Exit Strategies

What are you exiting? (What is your objective?)
a. Management
b. Ownership
   - Cattle
   - Real estate
c. Succession planning
d. Any combination of the above
Exit Strategies

How much lead time is needed?

a. Planning time – The decision process
b. Preparation time – Getting your “house” in order
c. Execution time - Implementation
d. Close out – Post exit

Exit Strategies

Assembling team of advisors

a. Spouse
b. CPA
c. Trusted personal advisor(s)
Exit Strategies

Things to consider

a. Method of sale or transfer
   - Private treaty
   - Auction

b. Timing
   - Real estate market
   - Cattle market
   - Tax climate

c. Re-inventing yourself (see article)

d. A will and possibly a trust is part of the process. Also consider a living will, durable healthcare power of attorney, disability insurance, and life insurance, etc.

e. Tax consequences, debt obligations, etc.

Exit Strategies

Financial Considerations

General Tax and Debt considerations to address prior to Exiting a Dairy Business

Jeb L. Rainey, CPA
The Rainey Accounting Firm, LLC

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Exit Strategies
Financial Considerations

Do you *know* what your current net worth is?

Assets – Liabilities = Net Worth

*Or*

“Stuff” you own – Amounts you owe = What’s left (i.e. what’s yours)

Exit Strategies
Financial Considerations

Exit – will it be a *Succession* or a *Sale*, or BOTH?

- A Succession by someone who will purchase the business from you over time would allow you much more flexibility in planning for cash flows and taxes.

- A Sale acts as the triggering event for tax purposes and the taxes will usually be due soon after the sale of your business as a whole or of your underlying assets.
Exit Strategies
Financial Considerations

To be prepared to exit, you must know:

- The total cost of the exit (i.e. the transaction cost as well as the “tailing down” cost of operations)
- Your total liabilities
  - Beware of “off-balance sheet” items
    - Deferred Tax Liabilities
    - Leases
    - Post-closure costs for oxidation ponds, lagoons, etc.
    - Other Contractual Liabilities (i.e. supplier purchase agreements)
- The expectations of your creditors upon an exit (i.e. acceleration of your obligations, even if you owner finance the sale)

Exit Strategies
Financial Considerations

Items to consider when contemplating an exit:
- Deferred income tax liabilities (they are probably higher than you think)
- Current and future tax rates (Federal & State)
- Potential sales tax liabilities
- Your current business structure (tax structure – corporation, sole proprietor, partnership, etc.)
- Sale of your assets (Personal Property, Real Estate, or both)
- Potential for section 1031 like-kind exchange(s)
- Timing of your sales (consider spreading them over 2 or more tax years through multiple transactions or installment sales)
- Timing of payment of “bank” loans
- Timing of payment of taxes (and related underpayment interest – if applicable)
- Estate tax effects
- Need for Life and (or) disability insurance
Exit Strategies
Financial Considerations
Potential Taxes of an Exit, via a Sale of Assets

<table>
<thead>
<tr>
<th>Asset Type</th>
<th>Potential Tax Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Livestock</td>
<td>➢ Recaptured ordinary income and / or capital gains</td>
</tr>
<tr>
<td>Equipment</td>
<td>➢ Recaptured ordinary income</td>
</tr>
<tr>
<td>Real Estate</td>
<td>➢ Capital Gain, usually Long Term – consider 1031 Exchange</td>
</tr>
<tr>
<td>Prepaid Expenses</td>
<td>➢ Not usually an asset of the sale, but the net effect is additional ordinary income in final year.</td>
</tr>
</tbody>
</table>

Exit Strategies
Financial Considerations

Simple Formulas for “rough” estimates of income tax*:

Income taxes for final year of operations = (Current year income + Prepaid Expenses  + “Final Milk Checks”) x your income tax rate

Taxes on Assets Sold = (Sales Price – depreciated basis) x your marginal income tax rate**

*Does not include self-employment tax.

**If the gain will qualify for long term capital gain treatment, then the maximum long term capital gain rate could be substituted.
Exit Strategies

Financial Considerations

Parting Thoughts –

- Be proactive
- Talk with your CPA or tax advisor and get them involved *early* in the process
- Consider the need for a tax attorney in addition to your CPA
- Consider involving a financial advisor
- Keep your business records up to date and always know the total amount of your assets, liabilities and net worth

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Exit Strategies

Final Thoughts

- Accept the reality
  - You will exit
  - You will more than likely owe taxes
  - Your taxes will likely be one of your largest exit costs
  - You have more control if you are proactive
- Start the dialogue – set the date to have this discussion
- Develop your purpose for “life after dairying”
Current Status and Future of the Southeastern Dairy Industry

Presented to Southeast Dairy Herd Management Conference
By
Calvin Covington
ccovington5@cs.com
November 3, 2010

Outline

- Milk Supply
- Milk Demand - Sales
- Milk Prices – Producer, Farm, Consumer
- Thoughts on Future Direction
Southeast Milk Production 2000-2015

2000-2009
Annual Milk Production Per Farm: Southeast vs. U.S.
Milestone in Southeast Milk Pricing

- May 1, 2008 Class I Differentials increased from:  
  $0.10 to $1.70 per cwt.
- Atlanta + $0.70/cwt.
- Orlando + $1.40/cwt. Net +$1.18/cwt.
- Show what can happen if all southeast producers work together in partnership with USDA

Three Southeast Federal Orders Annual Fluid Milk Sales (mil. lbs.) and Per Capita Consumption (lbs.) 2000-2015
## Ten Southeast States: Milk Supply vs. Milk Demand

<table>
<thead>
<tr>
<th>Year</th>
<th>Supply (mil. lbs.)</th>
<th>Demand (mil. lbs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>13</td>
<td>10</td>
</tr>
<tr>
<td>2005</td>
<td>12</td>
<td>11</td>
</tr>
<tr>
<td>2009</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>2015</td>
<td>10</td>
<td>13</td>
</tr>
</tbody>
</table>

### Southeast Fluid Processors

- **67 fluid processors** in 2010
- **50 fluid processors** today
- 35 of 50 plants changed ownership since 2000

Future: More plant closing and ownership changes
Thoughts, Challenges, Opinions

- More effort increase milk per Southeast Dairy Farm
- Fluid milk pie not growing – continue to create challenges for retailers, processors, and producers
- Parts of proposed national dairy policy not good for Southeast

Future Southeast Milk Pricing Changes?

- If have Federal Order system – does more of pricing need to be included in minimum order price?
- All skim milk in Southeast be Class I?
- Class I milk price based less on manufacturing prices?
The dairy industry, much like almost every other industry, is facing environmental issues that must be addressed. While some of these concerns are real and others are the results of certain “agendas” and misconceptions, ignoring them will not make them go away. The dairy industry must be proactive in addressing these concerns and developing the solutions or others will do it for them and the dairy men and women will be left to complain about how inappropriate the solutions are. These issues include 1) new EPA regulations on water quality, 2) emerging concerns on the water quantity side, 3) air emissions rules, 4) rules regarding on-farm storage tanks, and 5) on-farm energy use.

EPA CAFO rules and Nutrient Management

As most of you are probably aware, in February 2003, EPA issued revised Clean Water Act (CWA) permitting requirements and effluent limitations for Concentrated Animal Feeding Operations (CAFOs). The revised regulations expanded the number of CAFOs required to seek NPDES permit coverage and added requirements applicable to land application of manure by CAFOs. Almost all the states in the Southeast updated and modified their state rules to account for these changes in EPA regulations and most dairies are operating under a permitting system developed for these rules.

In February 2005, the Second Circuit Court of Appeals issued its decision in Waterkeeper Alliance et al. v. EPA regarding legal challenges to the 2003 rule. Among other things, the court directed EPA to:

- Remove the requirement for all CAFOs to apply for NPDES permits. The original rules required all dairies with more than 700 cows to apply for a permit and the judge felt that only those proposing to discharge should need a permit., and
- Add requirements for Nutrient Management Plans (NMPs) to be submitted by CAFOs with their permit applications and reviewed by permitting authorities and the public. Permitting authorities should incorporate the NMP terms into permits they issue.

EPA published proposed rules in June 2006 and March 2008 describing how the Agency intended to address the court’s decision in the Waterkeeper case. In addition, a July 2007 final rule extended certain deadlines that CAFOs were required to meet from July 31, 2007 to February 27, 2009.

The final rule includes two key changes that address the Waterkeeper court decision. First, it revises the requirement for all CAFOs to apply for NPDES permits and instead requires only those CAFOs that discharge or propose to discharge to apply for permits. The final rule also provides a voluntary no discharge certification option for CAFOs that do not discharge or propose to discharge. A properly certified CAFO demonstrates to the permitting authority that it is not required to seek permit coverage. Second, the rule adds new requirements relating to NMPs for permitted CAFOs. CAFO operators were already required to develop and implement NMPs under the 2003 rule; the new rule requires CAFOs to submit the NMPs along with their NPDES permit applications. Under the new rule, permitting authorities are then required to review the NMPs and provide the public with an opportunity for meaningful review and comment on the plans. Permitting authorities are also required to include the terms of the NMP as enforceable elements of the permit. The final rule lays
out a process for including these facility-specific provisions in both individual and general permits. The final rule also addresses other aspects relating to the Waterkeeper court decision that mainly address dairy design and technology requirements.

So what does this all mean to a Southeast dairy? Well, it depends. As a result of this new rule, almost every state will need to update their state regulations and, according to my dialogue with EPA administrators at recent meetings, almost all of them are behind schedule in doing this. The first major change may result in many states actually requiring less dairies to seek Federal coverage under NPDES permits and more states developing their own permitting systems. Since the rules specifically state that only those dairies proposing to discharge are required to get the federal permit, many will claim that they are not discharging and thus do not need a permit. The rule specifically states that runoff from land application areas is not a discharge provided it is done in accordance with a NMP; this means that only discharges from the confinement area and waste storage structures are considered. The EPA cautions that dairies may want to either certify that they have no discharge or seek coverage as any discharges that do occur would be subject to penalties for both the discharge and the failure to have a permit. Dairymen should be involved with their state regulatory agencies to insure that changes made at the state level are both protective for the environment and reasonable.

The second change is actually more troubling to me as it requires the states to make NMPs on NPDES permitted operations subject to public review and to incorporate portions of this plan into the permit that the dairy is operating under. My belief is that NMPs were supposed to be planning tools on how a dairy will be operated and not a regulatory permit. It will be interesting to see how all of this evolves as it could result in producers not being able to change crop selections without revising their permits. In Georgia, where many producers obtain their NMPs through the public sector, I would expect county agents and other assistance providers to be less willing to help a producer knowing that these plans will become part of a regulatory permit.

One final note on the water quality rules is that EPA Enforcement of these rules has been stepped up in response to public concerns (See Enforcement Alert, EPA 2009). Even in States where the EPA has delegated the authority to State agencies, EPA inspectors have visited farms and conducted inspections. In areas such as the Chesapeake Bay and the Mississippi River Basin, animal feeding operations are being targeted as a source of nutrients. All dairy farmers should be cognizant of this and take the following steps to minimize their liability:

- Maintain permit coverage required by your state rules
- Have and FOLLOW a nutrient management plan developed for your facility
- KEEP APPROPRIATE RECORDS as outlined in your state rules
- Do everything possible and practical to minimize spills and discharges
- Maintain good relationships with your neighbors to minimize complaints

There are also some excellent resources on preparing for an inspection on the LPE Learning Center website and the CLEAN-East program is available to assist in nutrient management plan development (see references section).

**Water Quantity Issues**

While the tri-state water wars between Georgia, Florida, and Alabama gets the most press attention, population growth, economic development, increased drought frequency, and a better understanding of the need for protection of environmental in-stream flows will affect all of the southeast. Georgia is in the midst of a statewide water planning efforts and many other states in the region are also beginning their own planning processes. Permitting of agricultural water users has been around for a
while in some southeastern states and will be coming to others. Even without permitting, having good data on which to plan for future uses will be critical. While irrigation is by far the largest use on most dairy farms, significant amounts of water are used for drinking, cooling, waste management, and washing. Very little data is available beyond cattle drinking water needs and design estimates for waste management structures on how much water is actually used on dairy farms. Research is needed to document farm water use and to develop technologies for conserving and reusing water on the farm. Where possible, dairies that can access reclaimed water or that can collect and use rainfall and runoff will be rewarded in the future. Even though water is currently relatively inexpensive, there are utility costs in moving it around the farm and water conservation could yield economic returns in some cases. In others, it may be required to simply stay in business.

**Atmospheric Emissions Regulations**

There are several rules and regulations regarding air emissions at the Federal level that could impact some dairy farms. The Livestock and Poultry Environmental Learning Center website has several webcasts and publications that cover these in detail and should be consulted for more detailed information. There is little reliable information on the amount of pollutants that are emitted by dairies. Because of the large increase in the average size of AFOs in recent years, there has been increased awareness of the air quality issues associated with AFOs.

The EPA has authority to regulate hazardous air emissions under the Clean Air Act. On December 18, 2008, the US EPA published a final rule that clarified which livestock facilities must report air emissions from their facilities. The two laws covered by that publication include the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Emergency Planning and Community Right to Know Act (EPCRA). Animal agriculture was granted an administrative exemption from reporting air emissions that normally occur from raising farm animals under CERCLA. EPCRA reporting requirements do apply to Large CAFOs (more than 700 dairy cows). Farms that are not large Concentrated Animal Feeding Operations (CAFOs) according to NPDES permitting rules are exempt from reporting under EPCRA. EPCRA requires that, whenever there is a known release of a hazardous substance, the person in charge of a facility must notify state and local emergency responders.

Regulation of CAFO reporting is to be based upon ‘good faith emissions estimates’. A limited number of approaches for obtaining estimates are available (See LPE learning center website) and national studies are underway to estimate these emissions. For most types of animal feeding operations, ammonia emissions are likely to trigger a reporting requirement, with reporting of hydrogen sulfide being much less likely. Dairies are required to report if the ammonia exceeds 100 lbs/day or the hydrogen sulfide emitted exceeds 100 lbs/day. For the southeastern U.S., many of these tools estimate that around 1,400 dairy cows is the threshold where most dairies will exceed the 100 lb/day of ammonia reporting requirement for dairy farms. The rule clarifying the limited exemption is in the public record and was effective beginning January 20, 2009. For large CAFOs, a common interpretation is that there will be increasing liability for not complying with EPCRA following this effective date. Failure to comply with this requirement could result in fines up to $25,000 per day.

In 2009, a mandatory Greenhouse Gas Reporting rule was also published. This rule includes a manure management component for greenhouse gases. While efforts are underway to get this excluded, as it stands today, some [relatively large] livestock and poultry operations should be prepared to begin keeping records in January that will enable them to report 2010 GHG emissions to EPA in 2011. This rule requires reporting of GHG emissions by large sources and suppliers emitting
25,000 metric tons or more per year of CO2 equivalent emissions to submit annual reports to EPA. The gases covered by the proposed rule were carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFC), perfluorocarbons (PFC), sulfur hexafluoride (SF 6), and other fluorinated gases including nitrogen trifluoride (NF) and hydrofluorinatedethers (HFE). The final rule provides a table that estimates the facility size that would be needed to trigger the reporting requirement and dairy farms are listed as needing 3,200 cows. Congress has tried to limit this rule by not authorizing EPA to spend any funds on implementation of the manure management component of this rule but it is not clear if this means that dairy producers do not need to comply.

**On-farm Storage Tanks**

One final EPA rule that dairy producers should be aware of is the Oil Spill Prevention, Control, and Countermeasure (SPCC) Program. The goal of the SPCC program is to prevent oil spills into waters of the United States and adjoining shorelines. A key element of this program calls for farmers and other facilities to have an oil spill prevention plan, called an SPCC Plan. These plans can help farmers prevent oil spills which can damage water resources needed for farming operations. SPCC applies to farms which store, transfer, use, or consume oil or oil products, such as diesel fuel, gasoline, lube oil, hydraulic oil, adjuvant oil, crop oil, vegetable oil, or animal fat. Farms that store more than 1,320 US gallons in aboveground containers or more than 42,000 US gallons in completely buried containers; and could reasonably be expected to discharge oil to waters of the US or lakes, rivers, and streams are covered by this rule. If your farm meets these conditions, the SPCC program requires you to prepare and implement an SPCC Plan. Many farmers will need to have their plan certified by a Professional Engineer (“PE”). However, you may be eligible to self-certify your plan if your farm has a total oil storage capacity between 1,320 and 10,000 gallons in aboveground containers, and the farm has a good spill history (as described in the SPCC rule). The deadline for having these plans developed and implemented is November 10, 2010. There are more details on this rule at the EPA Compliance Assistance website and the LPE learning center has a webcast scheduled for this topic in November, 2010.

**On-farm energy use**

Dairy farmers should also be aware of on-farm energy use. Recent increases in energy costs and the availability of federal and state incentives for conservation could make investments in conservation technologies cost effective. Also, public concern (which directly impacts your market) over the sustainability and carbon footprint of the dairy industry could have substantial impacts on the dairy industry. While recent studies and reports confirm that the modern dairy industry is very efficient, especially compared to historic levels, reducing energy inputs is one of the easiest ways of reducing your carbon footprint. A New York study that conducted audits on 32 dairy farms found that the average farm could easily implement relatively minor changes with paybacks of less than 2-3 years that would result in electricity savings of more than 10% (Dairy Farm Energy Audit Summary). Milk cooling, ventilation, vacuum pumps, lighting, and water heating are some of the biggest electricity uses on dairy farms and there are a number of practices that can be used to reduce consumption in each of these areas. An audit would help you identify these opportunities.

The advancement of renewable energy technology is also a current hot topic that may impact dairy farms. Anaerobic digestion of manure on-farm has been around for years and is an opportunity for larger dairies, especially if other wastes can be treated for tipping fees. Anaerobic digestion typically reduces the carbon footprint of a dairy by about 20 -30 percent. (Rotz, 2010). Additionally, advances in solar technologies like solar water heating are making the pay-back on these investments shorter.
While all of these types of activities require time and effort, some producers may be able to take advantage of the current federal and state policy incentives to produce some of their own energy.

**Concluding Remarks**

Dairy farmers are facing a number of environmental concerns that are difficult to address in times of low milk prices and rising input costs. Most of the rules and regulations impact only the larger farms, however, it is important that even the smaller dairies exhibit good environmental stewardship. The industry must be able to convince both the policy makers and the general public that they are excellent environmental stewards. Avoiding direct discharges, maintaining appropriate nutrient management plans, documenting stewardship efforts through record keeping and public education, and maintaining positive relationships with your neighbors are all practices that will help individual producers. At the industry level, it will be important that we educate the general public on sustainability of the industry, collect the research to show policy makers the real environmental impacts of the industry, and maintain a positive working relationship with state and federal regulatory agencies.

**Sources of Information used and references:**


Livestock and Poultry Environmental Learning Center, see webcasts and resources available at: [http://www.extension.org/animal+manure+management](http://www.extension.org/animal+manure+management)


Southeast DHIA Update 2010

Daniel W. Webb
Department of Animal Sciences, University of Florida
Southeast DHIA, Inc.
dwwebb@ufl.edu

Data from DHIA herds in Alabama, Florida, Georgia, Mississippi, South Carolina and Tennessee were used to examine dairy production in the Southeastern United States. Data were obtained from files stored at Dairy Records Management Systems (DRMS), Raleigh, NC. Herds with data in the DRMS database as of mid-October, 2010 included: 321 Holstein herds, 44 Jersey herds and 60 herds of other breeds. In addition, the all DRMS average from 14,242 herds located in 41 states was used for reference.

Milk production for all 425 Southeast herds averaged 18,096 pounds (rolling herd average) which was 214 pounds per cow below last year. The 2X-305-day mature equivalent average was 20,260 pounds. Average 150-day milk was 61.7 pounds. Average peak milk was 67.5 pounds for first lactations and 89.8 pounds for older cows.

Herd size of Southeast herds averaged 296 cows per herd, up 7 from last year with 40% milking in lactation 1. All DRMS herds averaged 149 cows, with 38% first lactations. Herd turnover rate was 38 and 35%, respectively. Death loss averaged 8.2% for Southeast herds and 5.9% for DRMS herds. Southeast herds averaged 295 calvings and had 84 heifer calves per 100 cows on hand. Sixty-one percent of services were to proven AI sires. Southeast herds averaged 78% heifers with known sire identity, where the average DRMS herd was 87%. Average sire identity for adult cows was 56% for Southeast herds and 74% for DRMS herds. Average reported milk price was $18.60, up from last year’s $14.70.

Days to 1st service was 105 and first-service conception rate, 49%. Fifteen percent of cows were dry less than 40 days and 31% longer than 70 days. The actual, historical interval was 14.4 months. Calving difficulty scores above 4 were 5.5% for 1st-lactation cows. Average somatic cell count was 441 thousand compared to last year’s 465 thousand. Average SCC score was 3.5.

In comparing performance among breeds, Jersey and other breeds had lower death loss, reduced herd exits for reproduction and notably higher pregnancy rates.

Differences among Southeastern states were few, but Florida herds were considerably larger (847 cows per herd) and Alabama and Tennessee herds smaller (145 cows per herd) than the average. Average milk per cow was greatest in South Carolina.
Table 1. Comparison of Southeast Herds to All DRMS Herds 2010

<table>
<thead>
<tr>
<th></th>
<th>2009 Southeast</th>
<th>2009 DRMS</th>
<th>2010 Southeast</th>
<th>2010 DRMS</th>
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<tbody>
<tr>
<td>No. Herds</td>
<td>444</td>
<td>14640</td>
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<td>14282</td>
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<tr>
<td>No. Cows / Herd</td>
<td>289</td>
<td>146</td>
<td>296</td>
<td>149</td>
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<tr>
<td>No. 1st Lact</td>
<td>112</td>
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<tr>
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<td>Avg Days in Milk</td>
<td>202</td>
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<td>208</td>
<td>190</td>
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<tr>
<td>% Left Herd</td>
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<tr>
<td>% died</td>
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<td>8.2</td>
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<td>6.1</td>
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<tr>
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<tr>
<td><strong>Production</strong></td>
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<tr>
<td>Rolling HA Milk</td>
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* Southeast - includes 6 southeastern states
** DRMS - includes all herds processed by DRMS
All breeds.
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*Data from DRMS - Oct. 2010  Holstein Herds*
### Table 3: Comparison of Herds by Breed 2010

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<td># Calvings</td>
<td>326</td>
<td>163</td>
<td>164</td>
<td>116</td>
</tr>
<tr>
<td>% Dry &lt; 40 days</td>
<td>15</td>
<td>15</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>% Dry &gt; 70 days</td>
<td>31</td>
<td>24</td>
<td>32</td>
<td>23</td>
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<tr>
<td><strong>Genetics</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>% Bred to Proven bulls</td>
<td>61</td>
<td>55</td>
<td>63</td>
<td>61</td>
</tr>
<tr>
<td>% Bred to non-AI</td>
<td>36</td>
<td>22</td>
<td>13</td>
<td>21</td>
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<tr>
<td>% Heifers with Sire ID</td>
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<td>87</td>
<td>92</td>
<td>88</td>
</tr>
<tr>
<td>% Cows with Sire ID</td>
<td>52</td>
<td>73</td>
<td>88</td>
<td>83</td>
</tr>
<tr>
<td># Calves per 100 cows</td>
<td>82</td>
<td>90</td>
<td>100</td>
<td>90</td>
</tr>
<tr>
<td>% Birth Difficulty &gt;4 for 1st Lact</td>
<td>6.4</td>
<td>5.1</td>
<td>0.6</td>
<td>1.6</td>
</tr>
</tbody>
</table>

* Southeast - includes 6 southeastern states

** DRMS - includes all herds processed by DRMS
Control of Contagious Mastitis

Ben Shelton, DVM
178 Holstein Lane
Olin, NC 28660
(704)546-2210
rockycreekda@yadtel.net

As industry standards for milk quality continue to rise, more attention will need to be focused on what can be done at the farm level to improve milk quality. Some processors are now demanding milk with less than 250,000 SCC. In 1966, action was not taken in many instances until the SCC was over one million.

“It is important for the dairy producer of today to be aware of the negative perceptions some of the public has of our industry. We as a group have not stayed ahead in the education and truth telling that would put a positive light on our efforts to be the best stewards of the land, caretakers of the cows that supply our livelihoods, and to produce quality milk that all should be thankful to have. We as a group, also, need to support each other and encourage each other to strive to produce the highest quality milk, no matter the size or management style of the farm.”--- Barry Myers, dairy producer, Union Grove, North Carolina (2009 NMC Annual Meeting Proceedings, pg 94-95)

Milk cultures in many instances are not used until there is a problem. Many times these problems could be avoided if a regular monitoring program was in place to identify contagious organisms earlier. The organisms considered to be contagious are mycoplasma, *staph. aureus* and *Strep. Agalactiae*.

*Strep. ag* can be eradicated and controlled very well with dry cow therapy, but it is still seen in herds that are not dry treating. These herds are often purchased and become a source of infection in expanding herds.

*Staph. aureus* is present in a high percentage of herds, often times herds that are producing quality milk. Since the public has an awareness of the dangers of wound infections with *Staph. aureus*, milk with *Staph. aureus* in it may become an issue for processors to take note of.

Mycoplasma has been considered an organism primarily seen in large herds, but if you look for it, you will find it in all size herds and in herds that have not bought cows in years. After identifying one of these organisms in the bulk tank, the owner has to decide how much it is really costing him and if he wants to make the effort to rid his herd of the organism.
The use of in-line samplers and pooling of individual samples can reduce the cost in identifying problem cows. Once cows are identified, decisions can be made as to whether to treat the cow or cull.

In my opinion, the two limiting factors on many dairies are adequate cow housing and properly trained employees. More than 20% of the western operations offered milker training one to two times per year, while only 6% did in the east. Western dairies trained only new milkers on 54% of the dairies, while eastern dairies trained only new milkers on 34% of the dairies. Almost half of the dairies in the east provided no milker training, 16% in the west.¹

Controlling all forms of mastitis and especially contagious mastitis requires:
1. Identifying the organisms in the bulk tank
2. Properly maintained milking equipment
3. Well trained people to milk the cows
4. Dry treatment
5. Teat dipping
6. Culling chronic cows
7. Segregate treated cows if possible
8. Culture in-coming animals, including your own fresh heifers

¹ Udder Topics Vol 32, No. 5&6, November & December 2009
Nutrition and Reproduction in Dairy Cattle

José Eduardo P. Santos
Department of Animal Sciences
University of Florida, Gainesville
jesantos@ufl.edu

ABSTRACT

Nutrition has an important impact on the reproductive performance of cattle. Energy is the major nutrient required by adult cattle and inadequate energy intake has a detrimental impact on reproductive activity of the female bovine. Cows under negative energy balance have extended periods of anovulation. Postpartum anestrus, as well as infertility, is magnified by losses of body condition during the early postpartum period. Resumption of ovulatory cycles is associated with energy balance, and the underlying mechanisms seem to be associated with metabolic signals and regulatory hormones primarily insulin and insulin-like growth factor (IGF) I, which link nutritional status with gonadotropin secretion, re-coupling of the growth hormone-IGF system, and follicle maturation and ovulation. Feeding diets that promote increases in plasma glucose and insulin may improve the metabolic and endocrine status of cows in early lactation. Nevertheless, feeding excess of starch to promote increases in insulin and glucose might suppress intake of early lactating dairy cows, thereby precluding benefits to cyclicity. Feeding behavior of dairy cows during the transition period, particularly a decline in feed intake before calving, is associated with risk of postpartum uterine disease. Because metritis and more chronic forms of uterine diseases have profound negative effects on pregnancy in dairy cows, providing adequate bunk space and an environment to maximize feed intake might potentially improve fertility of dairy cows. Specific nutrients and dietary ingredients have been implicated in reproduction in cattle. Excess of dietary protein has been suggested as detrimental to fertility, although the evidence is weak. Addition of moderate amounts of supplemental fat to the diet improves energy intake, modulates PGF$_{2a}$ secretion by the uterus, affects ovarian dynamics, enhances luteal function and embryo quality, and has moderate positive effects on fertility. More specifically, some fatty acids (FA) might impact fertilization rate and embryo quality in dairy cows. On the contrary, some dietary ingredients, such as gossypol, when ingested in large quantities decrease fertility of dairy cows because of its negative effects on embryo quality and pregnancy maintenance.
INTRODUCTION

Selection of dairy cattle for milk yield has linked the endocrine and metabolic controls of nutrient balance and reproductive events so that reproduction in dairy cattle is compromised during periods of nutrient shortage, such as in early lactation. The energy costs to synthesize and secrete hormones, ovulate a follicle, and sustain an early developing embryo are probably minimal compared to the energy needs for maintenance and lactation. However, the metabolic and endocrine cues associated with negative energy balance (NEB) impair resumption of ovulatory cycles, oocyte and embryo quality, and establishment and maintenance of pregnancy in dairy cattle.

As the demands for milk synthesis increase, reproductive functions may be depressed when no compensatory intake of nutrients is achieved. Numerous recent studies have reported that reproductive performance is compromised by the nutrient demands associated with high levels of production. Milk yield increases at a faster rate in the first 4 to 6 wk after parturition than energy intake, consequently high yielding cows will experience some degree of negative balance of nutrients during the early postpartum period. When cows experience a period of NEB, the blood concentrations of nonesterified fatty acids (NEFA) increase, at the same time that IGF-I, glucose, and insulin are low. These shifts in blood metabolites and hormones might compromise ovarian function and fertility. It has also been reported that energy balance and dry matter intake (DMI) might affect plasma concentrations of progesterone (Vasconcelos et al., 2003; Villa-Godoy et al., 1988), which may interfere with follicle development and maintenance of pregnancy.

During the last decades, genetic selection and improved management of herds have dramatically increased milk production of dairy cows, at the same time that fertility has decreased (Butler, 2003). Selection for higher milk production in dairy cattle has changed endocrine profiles of cows so that blood concentrations of bovine somatotropin and prolactin have increased; whereas insulin has decreased (Bonczeck et al., 1988). These hormonal changes and the increased nutrient demands for production might negatively impact reproduction of dairy cows. However, adequate nutrition and sound management have been shown to offset depression of fertility in herds with average milk production exceeding 12,000 kg/cow/yr (Nebel and McGilliard, 1993; Jordan and Fourdraine, 1993).

Several nutritional strategies have been proposed to improve reproduction of dairy cattle with no detrimental effect on lactational performance. Maximizing DMI during the transition period, minimizing the incidence of periparturient problems, feeding of diets that promote increased concentrations of insulin in early lactation, adding supplemental fat to diets, and manipulating the FA content of fat sources are expected to benefit reproduction in dairy cattle.

However, factors such as high incidence of metabolic diseases early postpartum, poor body condition score (BCS) at first insemination, and excessive gossypol concentrations in plasma are detrimental to fertility of dairy cattle.
NUTRITION AND POSTPARTUM UTERINE HEALTH AND FERTILITY

Epidemiological studies have clearly demonstrated strong relationships between postparturient diseases and subsequent reproductive performance in dairy cattle. Cows diagnosed with clinical hypocalcemia were 3.2 times more likely to experience retained placenta (RP) than cows that did not have clinical hypocalcemia (Curtis et al., 1983). Whiteford and Sheldon (2005) also found that hypocalcemia was associated with occurrence of uterine disease in lactating dairy cows. Markusfeld (1985) reported that 80% of cows with ketonuria developed metritis.

A major risk factor for uterine disease is RP. Generally, cows with RP have increased risk of developing metritis compared with cows not experiencing RP. Both metritis and RP double the risk of cows remaining with uterine inflammation at the time of first postpartum insemination (Rutigliano et al., 2008). In the US, a recent USDA study (NAHMS, 1996) indicated that the incidence of RP in dairy cows was 7.8 ± 0.2%. A 2006 study on 5 dairy farms in Israel observed that RP was diagnosed in 13.1% (9.4 to 18.1%) and 9.2% (3.6 to 13.8%) of multiparous and primiparous cows, respectively (Goshen and Shpiegel, 2006). In the same study, metritis affected 18.6% (15.2 to 23.5%) and 30% (19.4 to 42.3%) of the multiparous and primiparous cows, respectively. Both RP and metritis can have devastating effects on reproductive efficiency in lactating dairy cows, with reduced conception rates and extended intervals to pregnancy (Goshen and Shpiegel, 2006). In fact, not only does the clinical disease negatively affect fertility of dairy cows; but subclinical endometritis, a disease characterized by increased proportion of neutrophils in uterine cytology without the presence of clinical signs of inflammation of the uterus, has major deleterious effects on conception rates of lactating dairy cows at first postpartum insemination.

A rising story suggests that feed intake and feeding behavior around parturition might mediate some of the increased risk for uterine diseases in dairy cattle (Hammon et al., 2006; Huzzey et al., 2007; Urton et al., 2005). Hammon et al. (2006) observed that cows developing uterine disease postpartum experienced reduced DMI beginning 1 wk before calving. Similarly, cows diagnosed with severe metritis after calving were already consuming less dry matter 2 wk prior to calving (Huzzey et al., 2007). In the same study, even cows that subsequently developed mild metritis had reduced DMI 1 wk before calving compared with cows with healthy uteri. The same group (Urton et al., 2005) observed that cows subsequently developing metritis spent significantly less time eating before and after calving than cows that did not develop metritis. These data indicate that suppressed intake of nutrients or alterations in feeding behavior prior to calving are major risk factors for development of metritis postpartum.

A potential link between nutrient intake and development of uterine diseases may be the immune status of the cow. Kimura et al. (2002) evaluated neutrophil function in 142 periparturient dairy cows from 2 herds by evaluating chemotactic and killing activity of those cells. The authors observed that 14.1% of the cows developed RP. Neutrophils isolated from blood of cows with RP had reduced ability to migrate to placental tissue and reduced myeloperoxidase activity, a marker for oxidative burst and killing activity of neutrophils. Interestingly, the reduced neutrophil function was observed between 1 and 2 wk prior to calving, which suggests that the reduced innate immune function may be part of the cause of RP rather than a consequence of the disease. In fact, cows that developed uterine disease, either clinical metritis or subclinical
endometritis, experienced reduced DMI and neutrophil function prior to calving (Hammon et al., 2006). These data strongly suggest that inadequate nutrient intake before calving might predispose cows to impaired immune function; and, subsequently, increased risk for uterine diseases that negatively affect reproduction.

Because intake of nutrients seems to influence energy status and immune function of dairy cows, both of which seem to be related to risk of uterine diseases; it is prudent to suggest that nutritional and management strategies that optimize nutrient intake around parturition should improve uterine health and subsequent fertility of dairy cows. Perhaps, of equal or greater importance than the diet composition is the environment to which the preparturient cow is subjected. Inadequate cow comfort, competition for space, and hierarchical status can influence the ability of the cow to consume nutrients; which can consequently predispose her to uterine disease (Hammon et al., 2006; Huzzey et al., 2007; Urton et al., 2005).

RESUMPTION OF POSTPARTUM CYCLICITY

The onset of lactation creates an enormous drain of nutrients in high producing dairy cows; which, in many cases, antagonizes the resumption of ovulatory cycles. During early postpartum, reproduction is deferred in favor of individual survival. Therefore, in the case of the dairy cow, lactation becomes a priority to the detriment of reproductive functions.

During periods of energy restriction, oxidizable fuels consumed in the diet are prioritized toward essential processes such as cell maintenance, circulation, and neural activity (Wade and Jones, 2004). Homeorhetic controls in early lactation assure that body tissue, primarily adipose stores, will be mobilized in support of milk production. Therefore, the early lactation dairy cow that is unable to consume enough energy-yielding nutrients to meet the needs of production and maintenance, will sustain high yields of milk and milk components at the expense of body tissues. This poses a problem to reproduction, as delayed ovulation has been linked repeatedly with energy status (Butler, 2003). Energy deprivation reduces the frequency of pulses of luteinizing hormone (LH); thereby impairing follicle maturation and ovulation. Furthermore, undernutrition inhibits estrous behavior by reducing responsiveness of the central nervous system to estradiol by reducing the estrogen receptor α content in the brain (Hileman et al., 1999).

Generally, the first postpartum ovulation in dairy cattle occurs 10 to 14 d after the nadir of NEB (Butler, 2003). Severe weight and BCS losses caused by inadequate feeding or illnesses are associated with anovulation and anestrus in dairy cattle. In fact, cows with low BCS at 65 d postpartum are more likely to be anovular (Santos et al., 2008); which compromises reproductive performance at first postpartum insemination.
Prolonged postpartum anovulation or anestrus extends the period from calving to first AI and reduces fertility during the first postpartum service (Santos et al., 2008). In fact, anovular cows not only have reduced estrous detection and conception rates, but also have compromised embryo survival (Santos et al., 2004b). On the other hand, an early return to cyclicity is important in regard to early conception. The timing of the first postpartum ovulation determines and limits the number of estrous cycles occurring prior to the beginning of the insemination period. Typically, in most dairy herds, fewer than 20% of cows should be anovulatory by 60 d postpartum (Santos et al., 2008). Estrous expression, conception rate, and embryo survival improved when cows were cycling prior to an estrous synchronization program for first postpartum insemination (Santos et al., 2004a,b).

Resumption of ovarian activity in high producing dairy cows is determined by energy status of the animal. Therefore, feeding management that minimizes loss of body condition during the early postpartum period and incidence of metabolic disorders during early lactation should increase the number of cows experiencing a first ovulation during the first 4 to 6 wk postpartum.

**PROTEIN AND REPRODUCTION**

Lactating dairy cattle require large quantities of metabolizable amino acids for synthesis of milk protein. It is typical for lactating rations to contain crude protein between 16 and 18% of its total dry matter. Diets with limited crude protein can compromise microbial growth and rumen fermentation, which often reflects in declines in feed intake and milk production. On the other hand, feeding protein in excess to what is needed by the cows has been implicated in increased in ammonia and urea concentrations in blood and milk, which have been used as markers for reduced fertility (Butler, 1998). The suggested decline in fertility of cattle fed excess of protein is caused by alterations in uterine physiology with a decline in uterine pH during the early luteal phase of the estrous cycle (Butler et al. 1998). A more acidic uterine environment is less conducive with maintenance of pregnancy in cattle (Ocon and Hansen, 2003). This effect seems to be restricted to the early stages of embryo development (Rhoads et al. 2006).

Because high-producing lactating dairy cows are more efficient in utilizing protein sources when diets are moderate in crude protein and are balanced for the supplies of metabolizable protein and limiting amino acids (Noftsger and St. Pierre et al., 2003), it is not justified to feed diets with protein concentrations that will increase urea N and harm fertility.

**ENERGY AND REPRODUCTION**

Energy intake appears to have the greatest impact on energy status of lactating dairy cows. Villa-Godoy et al. (1988) reported that variation in energy balance in postpartum Holstein cows was influenced most strongly by DMI ($r = 0.73$) and less by milk yield ($r = -0.25$). Therefore, differences among cows in the severity of NEB are more related with how much energy they consume than with how much milk they produce.
During periods of NEB, blood concentrations of glucose, insulin, and IGF-I are low; as well as the pulse frequency of GnRH and LH. Plasma progesterone concentrations are also affected by the energy balance of dairy cows. These metabolites and hormones have been shown to affect folliculogenesis, ovulation, and steroid production in vitro and in vivo. The exact mechanism by which energy affects secretion of releasing hormones and gonadotropins is not well defined; but it is clear that lower levels of blood glucose, IGF-I, and insulin may mediate this process.

It has been suggested that NEB influences reproduction of dairy cows by impacting the quality and viability of the oocyte of the ovulatory follicle and the CL resultant of the ovulation of that follicle. Because there is substantial evidence that metabolic factors can influence early follicular development, it is conceivable that changes in metabolism during periods of NEB could influence preantral follicles destined to ovulate weeks later during the breeding period. To test this hypothesis, Kendrick et al. (1999) randomly assigned 20 dairy cows to 1 of 2 treatments formulated so that cows consumed either 3.6 % (high energy) or 3.2 % (low energy) of their body weight. Follicles were transvaginally aspirated twice weekly and oocytes were graded based upon cumulus density and ooplasm homogeneity. Cows in better energy balance (high energy) had greater intrafollicular IGF-I and plasma progesterone levels and tended to produce more oocytes graded as good. Therefore, NEB not only delays resumption of ovulatory cycles, but it might also influence the quality of oocytes once cows are inseminated.

**NUTRITIONAL MANIPULATION TO INCREASE ENERGY INTAKE**

Nutritional efforts to minimize the extent and duration of NEB may improve reproductive performance. The first and most important factor that affects energy intake in dairy cows is feed availability (Grant and Albright, 1995). Therefore, dairy cows should have continual access to a high quality, palatable diet to assure maximum DMI. However, DMI is limited during late gestation and early lactation, which can compromise total energy intake and reproductive performance. Several nutritional management strategies have been proposed to increase energy intake during early lactation. Feeding high quality forages, increasing the concentrate:forage ratio, or adding supplemental fat to diets are some of the most common ways to improve energy intake in cows.

A number of studies have demonstrated the importance of insulin as a signal mediating the effects of acute changes in nutrient intake on reproductive parameters in dairy cattle. In early postpartum dairy cattle under NEB, reduced expression of hepatic growth hormone receptor 1A (GHR-1A) is thought to be responsible for the lower concentrations of IGF-I in plasma of cows (Radcliff et al., 2003). Because IGF-I is an important hormonal signal that influences reproductive events such as stimulation of cell mitogenesis, hormonal production, and embryo development, among other functions; increasing concentrations of IGF-I early postpartum are important for early resumption of cyclicity and establishment of pregnancy.
It is interesting to note that insulin mediates the expression of GHR-1A in dairy cows (Butler et al., 2003; Rhoads et al., 2004), which results in increased concentrations of IGF-I in plasma. Because IGF-I and insulin are important for reproduction in cattle, feeding diets that promote greater insulin concentrations should benefit fertility. Gong et al. (2002) fed cows of low- and high-genetic merit isocaloric diets, that differed in the ability to induce high or low insulin concentrations in plasma. The diets that induced high insulin reduced the interval to first postpartum ovulation and increased the proportion of cows ovulating in the first 50 d postpartum.

FAT, FATTY ACIDS, AND REPRODUCTION

Feeding fat to dairy cattle usually improved the risk for pregnancy, although responses have not been consistent (Santos et al., 2009). When fat feeding improved production and increased body weight loss, primiparous cows experienced reduced pregnancy risk at first AI (Sklan et al., 1994); although pregnancy to AI was extremely high in the unsupplemented cows. However, Ferguson et al. (1990) observed a 2.2 fold increased risk of pregnancy at first AI and all AI in lactating cows fed 0.5 kg/d of fat, which tended (P = 0.08) to enhance the proportion of pregnant cows at the end of the study (93 vs. 86.2 %).

In grazing cows, supplementation with 0.35 kg of FA improved the risk of pregnancy after the first postpartum AI; although a similar proportion of cows were pregnant at the end of the study (McNamara et al., 2003). Feeding calcium salts of long chain fatty acids (Ca-LCFA) of palm oil improved pregnancy of dairy cows (Schneider et al., 1988), although the authors did not report statistical significance. On the other hand, others did not observe improvements in fertility of dairy cows supplemented with Ca-LCFA (Scott et al., 1995; Sklan et al., 1991) or oilseeds (Schingoethe and Casper, 1991); which might be attributed to increased milk yield and body weight losses (Sklan et al., 1991; Sklan et al., 1994).

Because the benefits of feeding fat may originate from specific FA (Staples et al., 1998; Staples and Thatcher, 2005), others have evaluated whether feeding FA differing in the degree of saturation might influence fertility of cows. The essential FA of the n-6 and n-3 families are available in much smaller supply to ruminants than nonruminants because of microbial biohydrogenation of FA in the rumen (Juchem, 2007), suggesting that their supplementation may benefit reproduction (Staples and Thatcher, 2005; Santos et al., 2009).

Three recent studies explored the role of n-6 and n-3 FA supplementation to lactating dairy cows on risk of pregnancy after the first postpartum AI (Ambrose et al., 2006; Fuentes et al., 2008; Petit and Twagiramungu, 2006). When cows were fed 0.75 kg of fat from flaxseed, a source rich in C18:3 n-3, or sunflower seed, a source rich in C18:2 n-6; pregnancy tended (P = 0.07) to be greater for cows fed n-3 FA. However, a similar response was not observed by others when cows were fed flaxseed as the source of n-3 FA (Fuentes et al., 2008; Petit and Twagiramungu, 2006). Similarly, feeding n-3 FA from fish oil as Ca-LCFA did not improve risk of pregnancy in high producing, lactating dairy cows when compared with a source rich in saturated FA (Juchem, 2007) or with Ca-LCFA of palm oil (Silvestre et al., 2008).
Juchem et al. (2009) evaluated the effect of feeding cows pre- and postpartum Ca-LCFA of either mostly saturated and monounsaturated FA or a blend of C18:2 n-6 and trans-octadecenoic FA. He observed that cows fed unsaturated FA had 1.5 times greater risk of pregnancy either at 27 or 41 d after AI compared with cows fed mostly saturated FA. Improvements in pregnancy risk when cows were fed C18:2 n-6 and trans-octadecenoic FA were supported by improved fertilization and embryo quality in non-superovulated lactating dairy cows (Cerri et al., 2004).

Because n-3 FA can suppress uterine secretion of PGF$_{2\alpha}$ (Mattos et al., 2002, 2003, 2004), it is thought that they have the potential to improve embryonic survival in cattle (Mattos et al., 2000). In 3 of 5 experiments, feeding n-3 FA either as flaxseed rich in C18:3 n-3 (Ambrose et al., 2003; Petit and Twagiramungu, 2006) or fish oil rich in eicosapentanoic acid (EPA) and docosahexanoic acid(DHA) (Silvestre et al., 2008) reduced pregnancy losses in lactating dairy cows after the first postpartum AI. On the other hand, when n-6 FA were fed as Ca-LCFA, pregnancy losses were similar to those observed for cows fed Ca-LCFA of palm oil (Juchem, 2007; Silvestre et al., 2008).

Collectively, these data suggest that feeding fat to dairy cows generally improves fertility and responses are observed when the energy density of the ration increased with fat feeding. Also, these data suggest that fertility responses to fat feeding is altered according to the type of FA supplemented in the diet. Feeding n-3 FA from oilseeds has improved pregnancy risk in some, but not all studies; however feeding n-3 FA as Ca-LCFA containing fish oils does not seem to influence risk of pregnancy. On the other hand, feeding Ca-LCFA rich in n-6 and trans-octadecenoic FA improved pregnancy in lactating dairy cows. Although feeding n-3 FA has not consistently improved pregnancy risk, it has reduced pregnancy losses in dairy cows.

**SOURCE OF SE AND REPRODUCTION**

During the immediate postpartum period, the cow’s immune system is challenged severely (Goff, 2006), and the innate and humoral defense systems are reduced. The incidence of diseases and disorders can be high during this time period and have a negative impact on reproductive performance. For example the risk of pregnancy (odds ratio) was reduced if cows had RP or lost one BCS unit (Goshen and Shpigel, 2006; Santos et al., 2008). Reduction in adaptive and innate immunity at parturition increases the risk of health disorders such as RP, metritis, and mastitis.

Selenium has long been associated with immunity. Cattle supplemented with Se-yeast had an 18% increase of Se in plasma in comparison to sodium selenite in some studies (Weiss, 2003). Some regions of the US are deficient in Se, particularly the Southeast; whereas other states, such as California, are mostly adequate in Se.

We have conducted an experiment to evaluate a supplemental source of organic selenium on reproductive and immune responses by dairy cows in FL and CA (Silvestre et al., 2006a,b; Rutigliano et al., 2008). Objectives were to evaluate effects of organic Se on health and reproductive performance of dairy cows.
Cows were assigned prepartum at approximately 25 d prior to expected day of calving to 1 of 2 sources of Se, organic Se (Se-yeast [SY; Sel-Plex®, Alltech) or inorganic sodium Se (sodium selenite, SS) fed at 0.3 ppm (DM basis) until 80 d postpartum. In both sites, cows followed the same study protocol and health was monitored daily throughout the study. Rectal temperature was recorded each morning for 10 d postpartum. In FL, vaginoscopic evaluation of the reproductive tract was performed at 5 and 10 d postpartum. Cows were evaluated for incidence of RP, metritis, puerperal metritis, subclinical endometritis by uterine cytology, ketosis, displacement of abomasum, and mastitis. Cows had their ovulation synchronized for first postpartum AI.

Plasma Se concentrations increased with days postpartum, but source of Se did not influence Se concentrations in cows in CA. However, in FL, feeding SY improved plasma Se concentrations (0.087 vs. 0.069 ± 0.004 μg/ml; P < 0.01). Incidence of postpartum diseases did not differ between treatments in both sites, but cows fed SY had smaller incidence of purulent vaginal discharge than those fed SS in FL. Diet altered frequency of multiparous cows detected with > 1 event of fever (rectal temperature > 39.5 °C; SY, 13.3 % [25/188] vs SS, 25.5 % [46/181]; P < 0.05); but the SY effect was not observed in primiparous cows, which had a much higher frequency of fever (40.5 %). Vaginoscopy discharge scores at 5 and 10 d postpartum were better for the SY group; namely, 47.1 (217/460) vs 35.0 % (153/437) clear, 43.4 [200/460] vs 47.8 % [209/437]) mucopurulent, and 9.3 (43/460) vs 17.1 % (75/437) purulent for SY and SS groups, respectively (P < 0.05). Feeding organic Se (SY) improved uterine health and second service PR during summer.

Diet failed to alter first service pregnancy rates in CA and FL, and second service pregnancy rate in CA. However, second service pregnancy rate in FL was greater for cows fed SY than SS [SY, 17 % (34/199) vs SS, 11.3 % (24/211); P < 0.05]. The benefit of SY on second service pregnancy rate is intriguing. We hypothesize that cows of the SY group were better able to reestablish an embryo-trophic environment at second service following either early or late embryonic losses.

Measures of innate and humoral immune responses were unaltered by source of Se in CA, but cows fed SY in FL had improved neutrophil function and serum titers against ovalbumin. Our findings indicated that feeding SY improved measures of humoral and cellular immunity, uterine health, and second service pregnancy rate in cows in FL; which is known as a Se deficient state. However, in CA source of Se had no impact on health, measures of immune response, or reproductive performance.

GOSSYPOL AND REPRODUCTION

Gossypol was first discovered by Chinese scientists after noticing that no children were born for more than a decade in a village where people cooked food with cottonseed oil. Since then, innumerous reports in the literature have confirmed the anti-fertility effect of gossypol in mammals.
Gossypol disrupts cell membrane metabolism, affects glycolysis, influences mitochondrial and energy metabolism in the cell, and increases fragility of cell membranes, such as in red blood cells. In fact, erythrocyte fragility has been one of the indicators of potential gossypol toxicosis.

Risco et al. (1992) were one of the first to show that gossypol can be toxic and even kill growing cattle. They fed rations with 200, 400 or 800 mg/kg of free gossypol (FG) to bull calves for 120 d. The diets with 400 and 800 mg/kg of FG were considered to be toxic and could potentially cause the death of growing ruminants. Baby calves have little ability to detoxify gossypol; therefore toxicity can be easily induced by feeding cotton products.

The negative effects of gossypol on fertility of ruminants are clear in males. Studies at University of Florida and Kansas State University have shown that as little as 8 g/d of FG fed to young bulls reduced sperm quality and sexual activity (Chenoweth et al., 2000; Velasquez-Pereira et al., 1998). However, the female ruminant seems to be relatively insensitive to the anti-fertility effect of gossypol because of rumen detoxification; but in vitro data indicate some inhibition of embryonic development and ovarian steroidogenesis (Randel et al., 1992).

More recently, a series of experiments by our group demonstrated that consumption of up to 40 mg of FG/kg of bodyweight did not influence follicle and luteal development in dairy heifers, but feeding a diet with 40 mg of FG/kg of body weight reduced embryo quality and development in vivo and in vitro (Coscioni et al., 2003a,b; Villasenor et al., 2008). These effects likely explain the reduced risk of pregnancy in dairy cows with high plasma gossypol concentrations (Santos et al., 2003), and compromised embryo survival after transfer (Galvao et al., 2006). Therefore, it is prudent to feed lactating dairy cows amounts of cottonseed that result in low plasma gossypol concentrations.

**IMPLICATIONS**

Inadequate intake of nutrients and inadequate body reserves during early lactation are the major factors affecting reproductive performance of dairy cows. Improving energy balance by increasing energy intake through additional non-fiber carbohydrates or supplemental fat in the diet reduces days to first ovulation and improves conception postpartum. Strong evidence suggests that management of cows during the prepartum period affects uterine health. Inadequate intake of nutrients prepartum and altered feeding behavior increases the risk of metritis in dairy cows. Supplementation with unsaturated FA of the n-3 and n-6 families usually improves fertility, as long as it does not interfere with rumen microbial metabolism. It is critical that improved methods to protect these unsaturated FA are required if precise calculations of the supply of unsaturated lipids are to be utilized in dairy cattle ration formulation to improve fertility.
Source of Se might influence health and reproduction of dairy cows, but response seems to be dependent upon the background Se concentrations in dietary ingredients. Lastly, although lactating dairy cows can consume substantial amounts of gossypol with no detrimental effects on health and lactation, when plasma gossypol concentrations exceed 5 μg/ml, embryo development and establishment and maintenance of pregnancy are compromised.

REFERENCES


In recent years the Chesapeake Bay has been a focus point for environmental impact studies. It is estimated that 95% of the phosphorus and 87% of the nitrogen entering the Chesapeake Bay arise from nonpoint sources. Agriculture accounts for 29% of the nitrogen and 49% of the phosphorus. Concern over the impact of excessive nitrogen and phosphorus entering the Chesapeake Bay led to the signing of the 1987 Chesapeake Bay agreement with the goal of reducing N and P inflows to the CB annually by 40 % (Chesapeake Executive Council., 1987). Although progress was made toward accomplishment of this goal, the reductions were not achieved by 2000. In 2000, a new agreement was signed reaffirming the commitment to 40 % reductions in nutrient loadings to the CB with the additional goal of removing the CB from the list of impaired water bodies under the Clean Water Act by 2010 (CBP, 1999). More recent investigation in 2010 by the EPA has determined that Virginia was 6% over their N allocation and 7% over their P allocation. Key focus areas for the Virginia Watershed Implementation Plan now include precision feed management for all animals housed on CAFO’s. Smaller farms would be subject to the same control programs but without the need to write feed management plans.

Our current regulations dictate the quantity of manure and fertilizer that may be applied to each plot of land. Manure containing excess quantities of N and P must be applied at reduced rates, potentially resulting in more manure produced than can legally be applied to the land. Accomplishment of net nutrient balance on the farm necessitates a precise feeding program that reduces the amount of overfeeding of crude protein (CP) and phosphorus (P) and optimizes use of homegrown forages.

Achieving improved nutrient balance on dairy farms sounds easier than it is. Frequently nutritional consultants are evaluated based upon productivity of the herd. Under these conditions they are more likely to add a margin of safety to the rations by overfeeding nutrients to assure that production goals are achieved. However, several factors are combining to encourage improved nutritional management of dairy herds.

- Research has enabled the development of computer models which enable one to more accurately predict animal nutrient requirements and therefore animal performance under a given set of environmental conditions and ration nutrient contents.
- The rapid increase in costs of energy and protein has provided an incentive for improved feed efficiency making overfeeding to provide a margin of safety too costly.
Improved tools are available to describe the nutrient characteristics of forages and concentrate ingredients.
New varieties of forages are being developed which foster higher whole plant digestibility.

In summary, there has been renewed interest in “precision” feeding of dairy cattle. Actually, precision feeding is a misnomer. Effective nutritional management first involves achieving accuracy, which in the nutritional sense means the nearness of the nutrient specifications of the ration to the desired nutrient specifications as formulated by the nutritionist. Precision means achieving the same results repeatedly. Therefore it’s important that our rations are accurate first then precise.

An additional challenge in achieving whole farm nutrient balance involves the availability of substantial quantities of economically priced byproduct commodities such as distiller grains, corn gluten feeds and brewer’s grains, which are high in protein and, of special concern, phosphorus. This is interesting in that at the same time that the federal government encourages the production of biofuels they are mandating increased environmental accountability of animal agriculture which is the primary route of disposal of these byproducts which are rich in phosphorus.

The title of this presentation is especially appropriate as it encompasses the complexity of the challenges as well as the opportunities faced by animal agriculture now and in the future. Nutrient management might be defined in this context as achieving a high level of nutrient efficiency by the animal unit with the result that minimal quantities of nutrients are excreted into the environment. Achieving profit has become increasingly challenging, especially given the uncertainty of milk price and the continued increase in cost of inputs, particularly feed. “Protecting the environment” can an additional benefit of better nutrient and economic efficiency of the feeding program.

In 2005, the Dairy Science Department at Virginia Tech received grants from the Natural Resources and Conservation Service and the Virginia Department of Conservation and Recreation to determine if precision feeding and incentive payments for reducing P in dairy cow diets could reduce nutrient losses from Virginia dairy farms. We are currently completing data collection which is the result of 4 years of work with 8 dairy farm collaborators in Virginia. This presentation will summarize the findings of this study to date. The primary focus will be to discuss the various factors involved in accurate ration mixing and delivery and the impact of “precision” feeding on whole farm nutrient management.

Nine treatment and 9 control farms were selected in 4 regions of Virginia. Herd sizes averaged 271 and 390 lactating cows for treatment and control farms whereas milk yield averaged 66 and 60 lb/cow/d, respectively. Crop acres grown averaged approximately 760 acres for both treatment and control farms. Treatment farms purchased and installed feed management software (TMR Tracker, Digi-Star LLC, Fort Atkinson WI) between May and October 2006. Data was collected for calendar years 2005 through 2009 to compute whole farm nutrient balance (WFNB) using software from the University of Nebraska.
On treatment farms, monthly samples were collected which included each total mixed ration (TMR) fed to lactating cows and all forages and commodities included in the TMR. Control farms submitted TMR samples every two months. Standard wet chemistry analysis of samples was performed. Data stored in the feed management software were collected monthly from each treatment farm concurrent with visit to obtain forage and feed samples.

**What did we learn? Protecting the environment.** A simple way to measure environmental stewardship by dairy farms is to estimate WFNB which is calculated by subtracting exports of nitrogen or phosphorus in the form of milk, animal’s crops and manure sold from the farm from imports in the form of purchased feed, fertilizer and animals. The use of feed management software resulted in a numerical, but not a statistical reduction in annual surplus of phosphorus per cow as shown in Figure 1.

![Figure 1. Average phosphorus surplus on treatment and control herds, kg/cow.](image)

Failure to achieve significant reductions in phosphorus surplus can be attributed to many factors, but the most likely reasons are that most dairy cattle rations do not require inorganic supplementation due to sufficient phosphorus provided by forage and concentrate ingredients commonly used in dairy rations in the U.S. In contrast, herds using feed management software experienced significant lower nitrogen surplus on a per cow basis as shown in Figure 2.
Figure 2. Average nitrogen surplus in treatment and control herds, kg/cow.

Although we have not evaluated the data from all four years of the project, a more in depth evaluation of the data from the first year of the study revealed that the mean daily feeding deviation was +380 lb. per load resulting in a variation in protein feeding of ++39 lb. and nearly 1 lb. of P. The challenge was that the standard deviation of the variation was 355 lb. per load, or almost as much as the mean deviation. In other words, the accuracy of the mixing the TMR was not very good and neither was the precision. A common measure of quality control in most manufacturing industries is to establish control limits of 1.5 standard deviations and that less than 5% of the product should be above these limits. Applying these concepts to TMR loading accuracy, 8% of the loads were under and 11% were over these control limits.

The deviations by individual farms are shown in Figure 3.

Figure 3. Mean and standard deviation in feeding on 9 dairy farms using feed management software.
This data reveals interesting characteristics of our cooperator farms and the differences between accuracy and precision. The solid bar represents the loading deviation and the line represents one standard deviation. Mean deviation of loaded vs. called weights was lowest for farm 10, but the variation was extremely large meaning that on the average loading was accurate, but precision was poor. The manager had delegated too much responsibility to the feeder and rarely reviewed information with the feeder to correct situations in which ingredients were added inaccurately or in too great amounts. Feeding management excelled in herds 9 and 3 in which the feeding programs were relatively simple and mixing was performed by one person with owner filling in when needed. The greatest problems were observed in herd 8 in which the owner did over 90% of the feeding and assumed that feeding was accurate without consulting feed management reports. In contrast, farm 6 consistently underfed cows and with very small variation.

What do deviations mean to herd profit? Obviously, consistent overfeeding is not profitable as research has shown that there is no economic return when protein and phosphorus are fed above nutrient requirements. Excess protein cannot be utilized by the cow and is excreted in milk, urine and manure. In addition, excess protein and phosphorus presents a disposal problem and contributes to increased N and P load on the farm. Many high protein products are also high in P. Therefore it is not uncommon that P tends to be excessive in herds which overfeed protein. Our data also demonstrated that production was higher in farms with greater accuracy and precision in their feeding programs.

What factors contribute to greater accuracy and precision in feeding management? Variation can be attributed to the equipment, personnel, and ingredients. **Equipment.** Most feed management programs provide scheduled reminders for mix wagon maintenance. However, we did not evaluate mixer scale accuracy. We found one brand of TMR mixer had large fluctuations in displayed weights during mixing and loading making it difficult to utilize the feed management software. **Personnel.** As would be expected, the feeder represents a considerable source of variation. We found that some feeders were consistently within 1 – 2% on loading accuracy. Managers on these dairies reviewed loading accuracy reports with feeders on a weekly basis. Feeders were classified as primary, secondary or relief. Primary feeders deviated on the average 1.57 +/- 0.54% whereas relief feeders averaged 1.26% +/- 0.59% per load. A third category of feeder was the occasional feeder and as expected they experienced the largest deviation. These deviations equate to approximately 95, 78, and 121 lb. per load. The fact that the primary feeder had larger deviations than the relief feeder might indicate that this feeder had developed poor loading habits or exhibited too much haste in loading the mixer. The full impact of loading accuracy on production and profit were not perceived by most dairies early in this study. It will be interesting to see if loading accuracy improves over time. Reports for loading accuracy were not fully utilized on some farms. Figure 4 is an example of a loading accuracy report available from the TMR Tracker program. Significant errors in mixing were encountered with Corn silage which was under loaded by 19% or 726 lb., haylage – over by 681 lb., wet brewer’s grains over by 264 lb., and distiller’s grains by 107 lb. in a 9990 lb. load. The impact of these errors on feed cost, nutrient balance and production will be discussed later in this document.
Figure 4. Ingredient deviation by driver report from the TMR Tracker program. This report represents one load mixed on February 1, 2009. Values highlighted in red have negative values and those in blue represent positive loading errors.

Ingredients. Nutrient analysis of TMR ingredients revealed that certain feedstuffs are more variable as shown in figure 5 below. Ingredients are listed from highest to lowest in crude protein content as illustrated by the bar. The liner indicates one standard deviation in protein content.
Figure 5. Crude protein content and variability of ingredients used in TMR rations. In addition to variation in nutrient content an additional concern is the variation in dry matter percent of forages and moist byproduct feeds. These challenges should dictate frequent on farm testing for dry matter and analysis of each load as a commodity is received on the farm. In addition to nutrient variation, certain feeds were more difficult to load. Comparison of deviation means for all ingredients demonstrated that loading of forages and byproducts with lower DM was less precise. The six feeds with the highest mean and standard deviation included all silages, hay, brewers’ grains and okara. Okara is a unique byproduct from the manufacture of soy beverage with low DM% and rapid losses in storage. Owing to its low cost and rapid spoilage, producers frequently included more in rations than called for.

What is the impact of poor feeding management on ration balance and nutrient excretion? The impact of overfeeding phosphorus on nutrient balance is demonstrated in Table 1. As amount of phosphorus included in the rations increases it becomes more difficult to meet requirements imposed by phosphorus-based nutrient management plans. In spite of anecdotal evidence, research fails to support the use of excessive levels of P in the diets of dairy cattle (Satter and Wu, 1999) as a requirement of effective reproductive performance.
Table 1. Impact of dietary P content on acres required for a 100 cow herd or maximum cows on 200 acres at different levels of dietary P. Assume 50% corn silage, 50% alfalfa silage-based ration

<table>
<thead>
<tr>
<th>Dietary P content, % DM</th>
<th>0.35</th>
<th>0.40</th>
<th>0.45</th>
<th>0.50</th>
<th>0.55</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acres required for 100 cow herd</td>
<td>107</td>
<td>128</td>
<td>149</td>
<td>170</td>
<td>191</td>
</tr>
<tr>
<td>Maximum cows on 200 acres</td>
<td>188</td>
<td>156</td>
<td>134</td>
<td>119</td>
<td>104</td>
</tr>
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</table>

Incorporation of improved models of nitrogen metabolism into ration formulation programs has enabled nutritionists to reduce crude protein levels in dairy cattle rations, thereby improving the nitrogen balance on dairy farms. The impact of poor feeding management can be demonstrated using the example shown in figure 4. Rations were formulated using the DM and nutrient intake of rations formulated as specified by the nutritionist and what was loaded by the feeder. These rations are shown in Table 2. Since we didn’t have nutrient values for some of the ingredients, “book” values were used for forages and byproduct feeds. A similar concentrate mixture was used in both examples. Note the differences between the two rations as an example of the impact of poor loading accuracy on nutrient efficiency and the potential for excess nitrogen and phosphorus excretion.

Table 2. Comparison of rations specified by nutritionist with those loaded by feeder for a Holstein cow in her second lactation weighing, 1350 lb, producing 80 lb of milk with 3.6% fat and 3.2% protein. Days in milk = 150.

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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Nutritionist specified</td>
<td>47.5</td>
<td>35.39</td>
<td>7.3</td>
<td>10.1</td>
<td>19.1</td>
<td>.3</td>
<td>.18</td>
<td>$5.73</td>
</tr>
<tr>
<td>Loaded by the feeder</td>
<td>49.1</td>
<td>36.43</td>
<td>8.0</td>
<td>10.8</td>
<td>20.4</td>
<td>.31</td>
<td>.19</td>
<td>$5.93</td>
</tr>
<tr>
<td>Difference</td>
<td>1.6</td>
<td>1.04</td>
<td>.7</td>
<td>.7</td>
<td>1.3</td>
<td>.01</td>
<td>.01</td>
<td>$.20</td>
</tr>
</tbody>
</table>

The differences are substantial, amounting to $.20 more per cow/day providing that cows will eat 1.6 lb. more DM, .7 lb. more protein and slightly more Ca and P per day from the ration loaded by the feeder. Another concern for inaccurate loading would be the influence of overfeeding of on farm forages on inventory projections. Over the past several weeks, this feeder had been over feeding haylage by approximately 10-15% and under on corn silage by a similar amount.
Summary

Based upon the recent history one should not expect much relief in corn and soybean prices. Combining this with erratic milk prices provides a tremendous incentive to increase nutrient and economic efficiency. Excellent nutritional models exist to enable formulation of rations which encourage high milk yield without excessive nitrogen excretion. However, the consulting nutritionist must have confidence that the herd’s nutrient requirement will be met. This can be achieved by:

- Accurately measuring intake by the cows in each group on the farm.
- Accurately describing dry matter levels and nutrient content of all forages and commodity feeds.
  - Measure dry matter of silages and wet byproducts on the farm at least weekly and more often if changes are perceived.
  - Analyze forages at least monthly for major nutrients. The use of NIR by forage testing laboratories has made this more economical. Every load of commodities should be tested upon delivery with analyses reported to the nutritionist on a timely basis. Use this information to make deficiency claims when delivered commodities don’t meet guaranteed minimums.
  - New TMR mixers are being introduced to the U.S. which incorporates NIR technology during the loading process. They provide real time estimates of feed DM levels as well as other nutrients.

Increased environmental pressures may dictate that producers utilize written feed management plans. The use of feed management software programs such as EZ-Feed, Feed Supervisor, Feed Watch or TMR Tracker, provides many tools for effective feed management including inventory control, estimates of shrink, loading and feeding accuracy and the opportunity to effectively share this information with the nutritionist. Our studies are showing that use of feed management software has proven effective in improving whole farm nutrient balance for nitrogen. Our cooperators have continued to use the software over the 4 years of the study. The prospects for improvement of phosphorus balance are less optimistic due to availability of low priced byproduct feeds which are economically attractive but high in phosphorus.

References:


Calf Rearing Programs that Balance Cost and Value

A.F. Kertz, Ph.D., Dipl. ACAN
Milk Specialties Global Animal Nutrition
St. Louis, MO
www.andhil.com

Introduction

There is increasing evidence that “calves never really get over a good start or a bad start.” While the calf period is the obvious starting stage for rearing dairy replacement heifers, the critical nature of this start is only recently being understood. This start influences how well calves do, not only as first-calf heifers, but apparently also in subsequent lactations too. Consequently, the feeding and management of calves must be balanced between minimizing costs and taking advantage of this most efficient period in converting nutrients to growth, but while not limiting lactation value later.

Bad Start

A series of veterinary studies supports the bad start component. Calves that had pneumonia during the first 3 months were 3.5 times more likely to die after 90 days of age, if they had a calfhood history of scours they were 2.5 times more likely to be sold than other calves, and if heifers were treated for scours, they were 2.9 times more likely to calve after 30 months of age than other heifers (Waltner-Toews et al., 1986). In an extensive NY dairy herd study involving 1,171 Holstein heifer calves, 7.4% had a respiratory problem and that resulted in these calves being less likely to enter the milking string, taking 6 months longer to do so, having more dystocia, and were culled sooner (Warnick et. al., 1995; Curtis et al., 1989; Correa et al., 1988). And FL data found that season of birth, occurrence of diarrhea, septicemia and respiratory disease, plus farm and birth weight accounted for 20 and 31% of variation in body weight and pelvic height at 6 months of age. If calves had septicemia and pneumonia, that slowed growth by 2 weeks. Authors attributed much of these issues as being due to lack of passive transfer of IgG influencing weight and height through its effect on health (Donovan et al., 1998).

Good Start

On the good start component, the best evidence is a study with a Brown Swiss herd in which calves at birth were force fed either 2 qt or 4 qt of colostrum at the first feeding (Faber et al., 2005). These 68 calves were then fed the same thereafter beginning with colostrum and transition milk for the following 2 days. Those calves fed the 4 vs 2 qt colostrum at the first feeding had:

- 60% less veterinary costs
- 0.5 lb more daily gain at 14 months of age
- 10% more 305-d ME milk during the 1st lactation (21,815 vs 19,712 lb)
- 17% more 305-d ME milk during the 2nd lactation (24,869 vs 21,232 lb)
Liquid Feeding Programs

The stage is now set for liquid feeding programs and expectations. The calf needs a liquid diet to provide for its body maintenance needs, plus growth—both of which are primarily related to energy and protein needs. The liquid diet empties into the abomasum and bypasses the rumen, which is not yet functional. A transition to the dry diet needs to occur which requires functional development of the rumen. And the calf needs to be in good shape to enter its first grouping, where too many changes at once will lead to stress and respiratory problems which will impair the calf for life.

In the previous presentation, various scenarios for milk replacer feeding programs were illustrated. One feeding scenario that was not illustrated is from an accelerated program (Figure 1). This milk replacer has 28% protein and 15% fat based on Cornell research showing this to be the optimal ratio for faster growth without excessive fattening (Tikofsky et al., 2001). Feeding a higher fat level in the milk replacer will limit starter intake resulting in less ADG (Kuehn et al., 1994) and more of a dip or slump during the once daily feeding week of milk during the weaning transition period.

Figure 1.
Form of Calf Starter

There are some troublesome issues about calf starters and young calf costs. While on a large dairy in 2007 that had about 200 calves that were less than 2 months of age, I observed calves were well-bedded with straw in hutches—a good set-up. Calves even had water and starter buckets well-separated, which means calves could not do what they will normally do if the buckets are adjacent. That is dribble starter into water and dribble water into starter, which decreases intake of both and lowers performance too. And water buckets were white—not black which can otherwise lead to hot water in the summertime. Use of black buckets under those circumstances can be misleading for if you walk by and see water in the bucket, you would think that is good. But the calf will not drink hot water. They will drink warm water, which they like, and which will minimize rumen temperature change when consumed (Dracy and Kurtenbach 1968).

But over a 15 minute period, I observed only one calf ruminating. Granted calves under a month of age are not likely to be ruminating, but the older calves with significant starter intake should be ruminating. The starter was pelleted which is popular with both feed companies because they are easier to make and cost less, and with dairies because they are easier to handle. And, after all, calves had straw (or hay) to chew on if they needed it. That sounds good from the view point of everybody, but what about for the benefit of the calf?

A key study (Porter et al. 2007) evaluated starters with 2 levels of fiber and in pelleted or mash (texturized) forms. Calves were in individual crates so there was no bedding consumption to confound the results. There were some benefits of the high fiber vs low fiber calf starter (Table 1). That is to be expected with lower starch content when starters are formulated for higher fiber. And there would be fewer tendencies for marginal ruminal acidosis with higher fiber content starters. But the main advantages in this study were for the texturized starter vs pelleted starter. Note the following (all different at P <0.05):

- Increased daily gain post weaning (5-8 wk), and overall as well.
- Increased starter intake after weaning, and overall as well.
- Earlier ruminating.
- Increased time ruminating.

In addition, calves sacrificed on each treatment had numerically increased rumen pH, papillae length, and % muscle/mucosa—all indicating greater rumen function and development consistent with the performance parameters.
Table 1. Effects of physical form of calf starter on performance.

<table>
<thead>
<tr>
<th></th>
<th>Pelleted</th>
<th>Mash (texturized)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily gain, 5-8 wk, lb</td>
<td>1.12&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.41&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Daily gain, 0-8 wk, lb</td>
<td>.70&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.90&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Starter intake, 5-8 wk, lb</td>
<td>86&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>112&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Starter intake, 0-8 wk, lb</td>
<td>105&lt;sup&gt;b&lt;/sup&gt;</td>
<td>134&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Week 1&lt;sup&gt;st&lt;/sup&gt; ruminating</td>
<td>6.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.7&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>% of time ruminating</td>
<td>8.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>21.0&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Rumen pH</td>
<td>5.0</td>
<td>5.4</td>
</tr>
<tr>
<td>Papillae length, cm</td>
<td>2.9</td>
<td>3.5</td>
</tr>
</tbody>
</table>

<sup>abP< 0.05</sup>

Now what about the straw or roughage situation? If calves can eat straw, how much will they eat? I do not know of any study measuring this. What would be the range and variation of straw consumption? What does the straw do in the rumen? We know it does not ferment much, produces the wrong balance of volatile fatty acids for rumen papillae development, and contributes to rumen fill which distorts and confounds true body weight (BW) gain and feed efficiencies. Several studies within the last several years have reported calf performance differences when calf starters differed in ingredients or physical forms. But these were confounded because hay (Kahn et al., 2007; Kristensen et al. 2007) was also fed, or straw was used for bedding (Bach et al., 2007). The rejoinder usually is “but texturized starters cost more”! That brings up another issue—costs.

Calf Starting Costs

A study in 2000 (Hoard’s Dairyman, 2000) summarized and reported calf and heifer costs (Figure 2) from 62 dairies in Wisconsin. Note that while daily costs were the greatest for the 2-month calf period, the largest component of that cost was 40% for labor followed by 38% for feed. Daily feed costs were actually greater for older heifers due to maintenance cost increasing with BW. Even though lower cost per lb or per ton feedstuffs can be used with larger heifers than with calves, the efficiency of nutrient conversion to growth is lower due to greater maintenance costs then. In fact, in some cases (Kertz et al., 1998; Brown et al., 2005a), cost per lb gain can even be the lowest during the calf period because of this greater efficiency of nutrient conversion to gain at lower BW. Furthermore, of the total costs to raise a heifer in that Wisconsin study, only $160, or 13% of the $1260 to raise a heifer, came in the first 2-month calf period. In 2000, a heifer calf was valued at $100, which would need to be added to the $1260 heifer raising costs to get a total cost of the heifer. Of the total heifer period rearing costs, 60% was feed costs, reflecting greater maintenance cost with increasing BW.
This study was essentially repeated in 2007 using 49 dairy operations, with four being custom calf grower operations. Some of the cost differences from the 2000 report are: a heifer calf was now worth $500 rather than $100, labor cost increased from $7 to 12/hour, and management cost increased from $12 to 20/hour. Results in Figure 4 illustrate a similar pattern to 2000, but with some accentuated differences noted in Table 2.

Table 2. Calf and heifer rearing costs in 2000 and 2007.

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2007</th>
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<tbody>
<tr>
<td>Heifer calf $</td>
<td>100</td>
<td>500</td>
</tr>
<tr>
<td>Calf period total $</td>
<td>160</td>
<td>326</td>
</tr>
<tr>
<td>% as feed costs</td>
<td>38</td>
<td>34</td>
</tr>
<tr>
<td>% as labor costs</td>
<td>40</td>
<td>47</td>
</tr>
<tr>
<td>% of total heifer costs</td>
<td>13</td>
<td>20</td>
</tr>
<tr>
<td>Heifer period costs $</td>
<td>1100</td>
<td>1323</td>
</tr>
<tr>
<td>% as feed costs</td>
<td>60</td>
<td>52</td>
</tr>
<tr>
<td>Total rearing costs $</td>
<td>1260</td>
<td>1649</td>
</tr>
</tbody>
</table>
From 2000 to 2007, calf value increased 5-fold while total calf period costs were “only” doubled. The latter was primarily a function of increased labor costs, which accounted for nearly one-half of the daily calf costs. Calf period costs increased from 13 to 20% of total heifer rearing costs from 2000 to 2007. Here is the concern. There is often undue focus on cutting calf feed costs. If lower quality milk replacer, lower feeding level, or lower cost calf starter were used, this might save $25-50 per calf. That would be only 15% at the maximum of the daily calf costs, and be only 2 to 3% of total heifer rearing costs. Poorer nutrition would then be provided to the most vulnerable and responsive growing animal on the dairy when the efficiency and return is the greatest. The best approach to cut calf period costs would be to reduce weaning age from an average of 8 to 6 weeks. This would reduce both the cost of the liquid feeding program and labor—the largest cost components of caring for and raising calves, but would not reduce calf performance. And the calf would now be in a better situation for moving into a group and ration change after 2 months of age. Additionally, more hutches are not needed, the calves will have another 2 weeks in their individual hutch before having to go into their first grouping, and they should have more rumen functional development to first begin using forage. With good milk replacer and calf starter feeding programs, that is a very realistic approach.

**Longer Term Effects**

There are newer data that suggest increased daily gain of the calf without excessive fattening before weaning is associated with increased first lactation milk yield. University of Illinois data (Drackley, 2008) showed that greater ADG achieved with an accelerated growth program
resulted in more 305-d milk ($P < 0.01$) in the 1st lactation (14% increase in Trial 1 and 4% increase in Trial 2). However, there was no difference in age at first calving (AFC) with conventional or accelerated calf programs in these two trials. The difference ($P < 0.01$) in results between the two trials is indicative of the many variables that influence calf performance and subsequent milk production.

Feeding an intensified milk replacer at a higher level and for a week longer resulted in calves gaining more weight and height at 56 days than a conventional milk replacer or than the same accelerated milk replacer fed at lower levels and for a week less (Raeth-Knight et al. 2009). While these calves fed a higher level of accelerated milk replacer and for a week longer had greater preweaned feed costs per unit gain, they also calved 20 days sooner and produced 5.6% more milk in their first lactation. However the number of lactations available in this data set is too limited to show significant differences given normal variation in lactating length studies.

Researchers at Cornell University (Soberon et al, 2010) developed a Test Day Model, similar to that used to summarize and analyze milk production data. It evaluates calf performance in relation to lactation data after factoring in birth weight, weaning weight, height at weaning, weight at 4 weeks of age, and several other factors within a herd. The greatest correlation with 1st lactation milk production was growth rate prior to weaning. In that data set with a range of 0.52 to 2.76 lb ADG, for every incremental lb increase in ADG prior to weaning, heifers produced about 1,000 lb more milk. Another data set of 500 heifers from 3 herds raised by a large calf and heifer ranch in Spain (Bach et al. 2008) found a similar relationship between ADG by 65 days of age and 1st lactation milk production.

How might this relationship occur? Possibly by increased mammary cell growth at a young age related to increased nutrient intake. Calves fed an accelerated program had 32 to 47% more mammary DNA compared with calves fed a conventional 20/20 milk replacer (Brown et al., 2005b). The increase in mammary DNA content prior to weaning may be essential to future milk production. Just as height increase missed during the first 6 months of life for a heifer cannot be “compensated” later in life, it is likely that missing this opportunity for mammary cell development before weaning cannot be realized later in the heifer’s growth period.

These accelerate fed calves (Brown et al. 2005a), when weaned at 7 wk and sacrificed at 8 wk for body composition, significantly ($P < 0.01$) gained more weight and height with greater feed efficiency and a lower cost per lb gain (Table 3). Body composition components were similar, indicating that accelerate fed calves did not have greater weight gain due to fattening.

<table>
<thead>
<tr>
<th>% protein/% fat</th>
<th>20/20</th>
<th>28/15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lb gain</td>
<td>35</td>
<td>62</td>
</tr>
<tr>
<td>Inch height gain</td>
<td>2.4</td>
<td>3.1</td>
</tr>
<tr>
<td>Gain/feed</td>
<td>0.44</td>
<td>0.55</td>
</tr>
<tr>
<td>$/lb gain</td>
<td>1.31</td>
<td>1.24</td>
</tr>
</tbody>
</table>
Issues and Questions

Since there are indications that even at this young calf age, critical mammary gland development is taking place, what can/should be done?

- Re-think how we look at calf starters and liquid feeding programs. Look to maximize performance of calves rather than simply to cut costs of calf feeding programs. Otherwise, negative consequences can accrue for the most vulnerable, responsive, and efficient growing animal on a dairy. Furthermore, there are now indications that future milk yield can be affected.

- Check and track serum total protein levels and use to monitor and correct colostrum administration deficiencies.

- Track and evaluate your calf records for scours, respiratory problems, and treatment costs. Look at when these occur: by week, before weaning, after weaning, in the first grouping, etc. Is there a pattern relating serum protein level with calf source, year, time of year, age of calf, day of week, time of day, etc.?

- Set up and use records to be able to back-track animals to see how early calf performance may have affected subsequent heifer growth and performance. A calf with a respiratory problem may get lost in the group unless tracked for performance. It required looking at a year of records from 2,771 heifers (Bach et al., 2007) before being able to find reduced final BW and increased age for first-calf heifers being associated with 5 or more treatment days for respiratory problems. And this was when close daily observations and treatment management of calves for respiratory problems was the protocol. Is it a better economic decision to cull that heifer when young, rather than feed and manage for 1-2 years before noting that it required more time and more costs to raise that heifer? And remember it is more likely that calf will struggle later at its first calving, not do well in the first lactation, and be culled then or after going into the second lactation.

- If you are a calf or heifer grower, how do you capture the value in how you feed and manage animals when the dairy may not recognize the benefit beyond just getting back an alive and apparently healthy heifer?
References


Dracy, A. E. and A. J. Kurtenbach. 1968. Temperature change within the rumen, crop area, and rectal area when liquid of various temperatures was fed to calves. J. Dairy Sci. 51:1787-1790.


Hoard’s Dairyman. 2000. Real herds, real heifers…Here’s the low down on daily growing costs. April 25, p. 302-303.


Animal Welfare and NMPF’s FARM Program

Karen Jordan, DVM
Large Animal Veterinary Services
Siler City, NC
Kjordan358@gmail.com
# Table of Contents

**Chapter 1** ........................................ 2  
Animal Care Quick Reference  
User Guide Overview

**Chapter 2** ........................................ 3  
On-Farm Evaluations

**Chapter 3** ........................................ 4  
Management – Standard Operating Procedures (SOPs), Training and Record Keeping

**Chapter 4** ........................................ 5  
Newborn Calves

**Chapter 5** ........................................ 7  
Nutrition

**Chapter 6** ........................................ 9  
Animal Health

**Chapter 7** ....................................... 12  
Housing and Environment

**Chapter 8** ....................................... 14  
Handling, Movement and Transportation

**Chapter 9** ....................................... 15  
Special Needs Animals

**Chapter 10** ..................................... 17  
Dairy Beef

**Chapter 11** ..................................... 17  
Third-party Verification
Chapter 1: Animal Care Quick Reference User Guide Overview

The Animal Care Quick Reference User Guide is a convenient resource summarizing best practices that should be in place on your farm to assure success in the National Dairy FARM Program.\textsuperscript{TM}

Created by the National Milk Producers Federation (NMPF), with support from Dairy Management, Inc. (DMI), the National Dairy FARM Program is a nationwide, verifiable animal well-being program that provides consistency and uniformity to best practices in animal care and quality assurance in the dairy industry. Voluntary and available to all producers, the program includes education, on-farm evaluations, and third-party verification to ensure the validity and integrity of the program.

The dairy industry has an excellent track record of responsible management practices; this national effort simply brings consistency and uniformity to on-farm care and provides reassurance to consumers.

We encourage you to use the Animal Care Quick Reference User Guide as a supplement to the National Dairy FARM Program Animal Care Manual and accompanying animal care training video. The Animal Care Manual and video are comprehensive tools that provide more detail about the program, on-farm evaluations, best practices, management checklists, and third-party verification. The Animal Care Manual also includes definitions of important terms, an appendix, and lists of additional resources.

For best outcomes and a full understanding of the National Dairy FARM Program, it's important that you thoroughly review the Animal Care Manual and watch the training video.

Chapters 2 and 11 of the Animal Care Quick Reference User Guide address on-farm evaluations and third-party verification, respectively. The remaining chapters include animal care topic summaries and management checklists, which include best practices in the following categories:

- Management
- Newborn Calves
- Nutrition
- Animal Health
- Housing and Environment
- Handling, Movement and Transportation
- Special needs Animals
- Dairy Beef

Thank you for your participation. U.S. dairy farmers have a longstanding commitment to doing what's right. Your decision to be a part of the National Dairy FARM Program illustrates that dedication and is an important step in assuring consumers that you care for the safety, comfort, and well-being of your animals and that the dairy products you produce are safe, wholesome, and nutritious.

If you have questions about the National Dairy FARM Program please call NMPF at (703) 243-6111 or log on to www.nationaldairyfarm.com.

Program Management: NMPF is managing the production and dissemination of technical animal care manuals, producer education and training, on-farm evaluation and third-party verification. DMI is assisting with communication, specifically to producers and industry, as well as potential communication to the market chain and consumers.
Chapter 2  On-farm Evaluations

The on-farm evaluation provides an external review of animal care practices based on National Dairy FARM Program guidelines. The results of the initial evaluation will provide the producer with a status report and enable the producer to develop an action plan for continuous improvement if necessary. Subsequent evaluations will enable the producer to track progress in on-farm animal care.

A veterinarian, co-op extension agent, co-op field staff member, university personnel, or otherwise qualified personnel, who have completed National Dairy FARM Program training can perform an on-farm evaluation. Evaluators will use the National Dairy FARM Program management checklists to conduct the evaluation.

The same on-farm evaluation will be used by third-party verifiers for farms that are randomly chosen through statistical sampling for program verification.
Chapter 3  Management - Standard Operating Procedures (SOPs), Training and Record Keeping

When addressing management, it is important to describe the procedure, train to the procedure, document the completion of the training, and monitor it over time. Although verbal directions are acceptable as long as all employees are following the protocol and procedure in the same manner, written SOPs are preferred. Train and educate animal caretakers about animal care expectations and animal well-being policies. The operation should have a Herd Health Plan, as well as training and protocols for handling, transporting and caring, and euthanasia for cattle of all ages and health conditions.

YES  NO  DON'T KNOW

The dairy has a Veterinarian/Client/ Patient Relationship.

Documentation exists of employee training for new and existing employees at least on an annual basis.

SOPs are readily available, and in many cases posted, in the native languages of employees assigned animal care responsibilities.

An emergency plan is readily available to address animal care needs arising from unique circumstances such as a fire or natural disaster.

Each animal is permanently identified and an effective record keeping system is employed for animal care and management decision-making.

A specific milking routine, procedures, and actions are followed to ensure cow comfort and well-being.
Chapter 4  Newborn Calves

NUTRITION  Providing an adequate volume of high-quality colostrum or colostrum replacer is critical to calf health because calves depend on colostrum for immunes protection. After receiving immunity through feeding colostrum or colostrum replacer, calves should be fed milk or milk replacer through weaning. Calves should have continuous access to fresh water, or provided water at least twice a day, that is free of contaminants or pollutants. Within two weeks after birth, calves to be retained on the dairy should be offered a palatable, high-quality starter ration (no forage).

Calves receive colostrum or colostrum replacer soon after birth.  
Calves are fed milk or milk replacer until weaned.  
Calves without continuous access to water are provided water at least twice per day or as necessary to maintain proper hydration.  
Calf rations should provide the required nutrients or maintenance and growth as found in references such as the National Research Council, 2001.

ANIMAL HEALTH  The Herd Health Plan (preferably written), developed in conjunction with a veterinarian through a Veterinarian/Client/Patient Relationship (or other knowledgeable professional such as cooperative extension agents), should include information specific to the care of newborn animals. Topics in the Herd Health Plan relevant to newborn animals include colostrum management, navel dipping, identification and record keeping, and protocols for vaccination, dehorning, super-numerary teat removal, castration, tail docking, and euthanasia.

The dairy has a Herd Health Plan, developed in consultation with the herd veterinarian (or other knowledgeable professional such as cooperative extension agents), which includes specific areas pertaining to newborn animals:

Navel are dipped in an effective antiseptic solution as soon as possible.

Animal identification and animal health records are maintained.

Vaccinations for common diseases are administered for disease prevention.

Medical procedures are performed as soon as possible and with appropriate use of analgesics and/or anesthetics.
Chapter 4
Newborn Calves

HOUSING AND ENVIRONMENT A clean, dry, well-lit, well-ventilated calving area has many health benefits for the calf at the time of birth. A separate calving area (maternity pen or paddock) that is designed to be comfortable, functional, and hygienic allows for close observation of the cow and easier, more effective assistance at calving. Calves and young stock should be given space to stand, lie down, and turn around without difficulty. Calves should be protected from extreme temperatures, wind drafts, and precipitation during periods of seasonal weather extremes.

A clean, dry, well-lit, well-ventilated calving area is used.  

Calves are housed in a clean, dry area with adequate space to stand, lie down, and turn around without difficulty.  

Calves are protected from extreme temperatures, wind drafts, and precipitation during seasonal weather extremes.

HANDLING, MOVEMENT AND TRANSPORTATION Employees should be properly trained to handle animals with a minimum of stress to the animal, and the consequences of inhumane handling should be known and enforced. Handling facilities, including trailers, must be well maintained and free of objects such as broken boards or rails that may cause bruising. The transit of calves should be safe, humane, and comfortable in order to ensure their health, quality, and market value.

Calves are moved by lifting or walking.  

Personnel are trained to handle and restrain calves with a minimum of stress to the animal.  

Vehicles used to transport calves are clean, properly designed, and maintained.
Chapter 5 Nutrition

WATER. Fresh, clean water is just as important to animals as nutritious forages and concentrates. When continuous access is impossible for other classes of animals besides lactating cows and non-lactating cows, make water available for 30 minutes at least twice daily. More frequent watering may be necessary, depending on the cow’s feed intake and milk production, and the weather (see Water Consumption of Dairy Cattle Table in Animal Care Manual). Water should be prevented from freezing in cold weather. Waterers should be convenient for the animals to reach on demand, and there should sufficient waterers (number, size, and capacity) to accommodate the number of animals in the herd or lot. Footing should be firm and dry in watering areas. Animals should not be able to wade in drinking water. Water should be fresh and free of harmful contaminants, especially human and animal waste, which may introduce pathogens into the human food chain.

<table>
<thead>
<tr>
<th>Water is tested periodically if recommended by the Herd Health Plan (for example, nitrates, pathogens, minerals)</th>
<th>YES</th>
<th>NO</th>
<th>DON'T KNOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water is protected from freezing.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Procedures are in place for regular cleaning of waterers.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>All animals without continuous access to water are provided water at least twice per day, or as necessary to maintain proper hydration.</td>
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<td></td>
</tr>
<tr>
<td>Waterers are positioned at a convenient height.</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Watering locations prevent a dominant animal from limiting water to other animals.</td>
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</tbody>
</table>

FEED. Feed considerations include nutritional quality and quantity, feed bunk design, and proper feed storage. Advances in ruminant nutrition science have greatly improved animal production. References such as The Nutrient Requirements of Dairy Cattle (National Research Council, 2001) should be used to provide the basis for ration formulation. Fence line feeding or feed bunks should give animals easy access to the feed. Adequate bunk space per cow should be available to allow every animal feeding a balanced diet per feeding cycle. Feed should be pushed up several times daily.

Safely store bulk supplies of feed in appropriately designed areas to avoid moisture, vermin and bacterial or fungal contamination. Proper labeling of storage containers or areas, controlling moisture, and using an effective program of vermin control will help assure maintenance of feed quality and safety. Make sure medicated feeds are stored separately and are properly labeled. Store toxic compounds outside of the feed storage area and outside of the animals’ resting area. Feed should be protected from environmental contamination, and access to birds and animals should be restricted.
Rations should provide the required nutrients for maintenance, growth, and lactation for the appropriate physiological life-stage as found in references such as the National Research Council, 2001.

Cows are not restricted from feed for more than four hours at one time.

Feed equipment is washed and disinfected after being used for non-feed purposes.

Feed for other species is never mixed with dairy animal feed.

Home-grown or purchased feed ingredients and commodities are checked for nitrates, mycotoxins, or other soil- or climate-induced problems, as recommended by the Herd Health Plan.
Chapter 6  Animal Health

HERD HEALTH  An effective Herd Health Plan emphasizes prevention, rapid diagnosis, and quick decision-making on necessary treatment of sick or injured dairy cattle. A licensed veterinarian, or other appropriately trained consultant, can help producers develop and implement a routine Herd Health Plan. While a Herd Health Plan can be verbal, a written Herd Health Plan is preferred for clarity. A sample Herd Health Plan is available from the National Dairy FARM Program.

The dairy has a Herd Health Plan, developed in consultation with the herd veterinarian (or other knowledgeable professional such as cooperative extension agents), to prevent common diseases such as mastitis, lameness, metritis, metabolic diseases, displaced abomasums, and infectious diseases such as pneumonia and infectious diarrhea. Should these conditions occur rapid diagnosis and treatment is instituted. The Herd Health Plan should include:

- Veterinarian/Client/Patient Relationship.
- Vaccination protocols.
- Daily observation of all cattle for injury or signs of disease.
- Protocols for newborn calf management (see Chapter 4 text boxes for additional details).
- Protocols for cattle that develop disease or are injured.
- Protocols for prevention, detection and action for common diseases and parasite and pest control.
- Protocols for non-ambulatory animal management (see Chapter 9 text box).
- Protocols for euthanasia (see Appendix B).
- Protocols to ensure food safety.
- Training programs for family members and employees involved in detecting disease and injury, reporting the cases and actions to be taken.

Each individual animal should be permanently identified and an effective record keeping system employed for animal care and management decision-making.

ANIMAL MONITORING  Even with the best prevention programs, animals can become sick or injured. Observation is key to identifying health issues early in order to provide effective treatment.

Animals are observed daily to assess the following items:

- Hair coat
SANITATION

Proper sanitation and waste management keep animals dry, clean, and free of manure and provide them with comfortable, healthful surroundings. The goals of sanitation for animal facilities are to minimize animal disease, pests and parasites, spread of pathogens, and generation of odors and dust. Basic sanitation practices include keeping the interiors, corridors, and storage spaces of animal facilities clean, cleaning waste removal implements frequently, and emptying waste containers. Facilities should be free of standing water, excess manure, unnecessary farm items, and clutter.

Sanitation may be achieved by heat, chemicals, or high-pressure washing, or by manually scrubbing equipment and surfaces in the facilities with appropriate detergents and disinfectants. Manure should be removed regularly from facilities and free stalls. At least daily scraping or flushing of traffic areas and walkways improves sanitation and traction. Individual free stalls should be cleaned and groomed daily. Sand or other products provide excellent materials for maintaining sanitation of animals.

LOCOMOTION

Foot care is important to the well-being of all cows. Lameness will interfere with movement to the milking, feeding, and watering areas, limit the exhibition of estrus, and influence general health. Routine examination and trimming of hooves can help prevent foot problems and infections. Whenever lameness (measured by locomotion scoring of 4 or 5) exceeds three percent of a herd, measures should be implemented. These may include footbaths, more frequent inspection, and hoof trimming as recommended by the herd health veterinarian. Locomotion scoring on a regular basis is recommended.

Ninety percent or more of the herd score 2 or lower on the locomotion scorecard (1-normal gait, 5-refuses to bear weight on one leg). (See Appendix D in Animal Care Manual)
BODY CONDITION SCORING  Achieving growth targets for heifers and monitoring change in body condition during gestation and lactation are very important. Body condition can change rapidly at and after calving and should be used to guide ration changes. Body condition scoring for dairy cattle is an important management tool for optimizing milk production and reproductive efficiency while reducing the incidence of metabolic and other periparturium diseases.

Ninety percent or more of the dairy animals should have a body condition score between 2.0 and 4.0 with no more than five percent of the dairy animals below 2.0 (1.0 is thin and 5.0 is over-conditioned). See Appendix A in Animal Care Manual.

HOCK LESIONS Hock lesions (swelling, abrasion, and even ulceration) are an important indication of inadequate bedding and lack of animal comfort. Dairy farms with a higher prevalence of hock lesions also tend to have a higher number of lame cows. A healthy hock is free from hair loss (the hair coat is smooth and continuous with the rest of the leg) and swelling.

Ninety percent of cows score 1 and 99 percent score 2 or less utilizing the NYSHAP “Hock Assessment Chart for Cattle” assessment (1 - no swelling, 3 - swelling evident). (See Appendix E in Animal Care Manual).

See "Specific Lifestyle Considerations" in Chapter 6 of the Animal Care Manual for more Herd Health Plan information on growing animals, breeding heifers, springing heifers, and mature bulls.
### Chapter 7  Housing and Environment

**ANIMAL ENVIRONMENT** Environmental temperature affects an animal’s comfort which, in turn, affects an animal’s behavior, metabolism, and performance. The temperature that the animal experiences and the effect on the animal is the net result of air temperature, humidity, air movement, shade, insulating effects of the surroundings, and the animal’s age, sex, weight, adaptation status, activity level, posture, stage of lactation, body condition, and diet. Air temperature, humidity, quality, and movement should be monitored carefully, especially during seasonal changes, to ensure animal comfort and prevent diseases.

Air quality affects the health and well-being of the animal and its caretakers. Quality is typically defined in terms of the air’s content of certain gases, particulate matter, and liquid aerosols. Adequate ventilation, be it natural or mechanical, helps prevent respiratory and other diseases by removing heat, water vapor, air pollutants, and odors from an enclosed animal facility at the same time that it introduces fresh air.

Lighting should allow inspection of animals and provide safe working conditions. Avoid quick movements and alarming sounds while working around animals.

<table>
<thead>
<tr>
<th>Practice</th>
<th>YES</th>
<th>NO</th>
<th>DON'T KNOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practices are in place to minimize the impact of heat and cold stress due to extremes in temperature; tools include the use of sunshades, sprinklers, misting fans, dietary alterations, wind breakers.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Airborne particles are minimized as a way to reduce odors and dust.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adequate lighting is in place to allow inspection of animals and to provide safe working conditions.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quick movements and alarming sounds are avoided while working around animals.</td>
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</tbody>
</table>

**HOUSING FACILITIES** To make all facilities safe and comfortable for the animals, there should be adequate space or floor area per cow, proper maintenance to remove any sharp or broken objects that may cause injuries, clean and dry bedding (if used), and non-slip flooring with minimal, if any, mud. An adequate amount of space helps prevent injury, unhygienic conditions, and behavioral problems. Producers need to assure that the animals each have enough room to stand, lie down, stretch their legs, eat, drink, and eliminate comfortably. When animals lie down, their hind legs should not extend into common traffic areas, curbs, or gutters. For appropriate freestall and stanchion/tie-stall dimensions, refer to the Animal Care Manual.

<table>
<thead>
<tr>
<th>Routine observation of facilities includes monitoring and taking action for:</th>
<th>YES</th>
<th>NO</th>
<th>DON'T KNOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manure removal.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moisture collection on roof or walls or frequent condensation on other metal surface.</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
Certain parts of building where animals refuse to rest or sleep.

Slip and falls, including installing nonslip walkways or alleys.

Cleaning all fans regularly.

Facility sanitation and waste management programs that result in clean animals (90 percent of all animal pens or groups score less than 3). (See Appendix C in Animal Care Manual)

Slip and falls, including installing nonslip walkways or alleys.

Stanchion/Tie Stalls
Animals are turned out daily for exercise (weather permitting).

Animals have room to stand and lie down (see specific guidelines for breed, size).

Animals have room to stretch, eat, drink, and discharge comfortably.

Manure is removed on a routine basis.

Free Stalls
Bedding is refreshed (remove soiled sand or other bedding material) and fresh bedding is added on a routine basis.

Stalls provide appropriate space to match size/breed of animal.

Water space, feed space, and shelter are provided for each animal housed.

Stocking rates allow for adequate time per animal for rest, exercise, and feed and water consumption.

Lunge space is provided to aid animal movement.

Air movement and/or cooling systems are provided for animal comfort.

Open Lot and Pastures
Management practices are implemented promptly so animals can avoid standing in mud after rains.

Animals can access shade during periods of heat stress or windbreaks during periods of cold stress.

See "Specific Lifestyle Considerations" in Chapter 7 of the Animal Care Manual for more information on housing dry cows, new animals, and mature bulls.
Chapter 8  Handling, Movement and Transportation

Cattle are to be handled in a calm, controlled, and gentle manner. Employees should be properly trained in animal handling and the consequences of inhumane handling should be known and enforced. Handlers should be assessed and retrained on a regular basis.

Animals should be handled by equipment appropriate for the procedure. Prods, canes, and other extreme cattle handling aids should only be used in situations that may potentially cause harm to the handler or the animals. Use of flags, plastic paddles, and a stick with ribbon attached are appropriate for handling animals that refuse to move through facilities, but only if minimal force is applied. Any force used must be applied calmly. In all cases, use the least amount of force necessary to control the animal and still ensure the safety of herdmates and caretakers.

Cattle should be moved in a manner that reduces the risk of slips and falls. Animals should be loaded and unloaded for transit in a manner that minimizes stress and anxiety. Transportation factors related to animal well-being include: facilities that are safe and comfortable to the animal, in-transit care provided by knowledgeable crews and drivers, uniformity of the animals loaded, and duration of the trip.

Individuals working in animal movement are trained on the principles of flight zones and flight distances to know the importance of controlling the animal movement in lanes, alleyways, and other parts of the complex. (See Appendix F in the Animal Care Manual)

The dairy uses the “Top 10 Considerations for Culling and Transporting Dairy Animals” in handling and transportation decision-making. (See Appendix G in the Animal Care Manual)

See “Specific Lifestyle Considerations” in Chapter 8 of the Animal Care Manual for more information on handling, moving and transporting transition cows and milking cows.
Chapter 9  Special Needs Animals

Even with the best care and adherence to the Herd Health Plan, animals can become ill, require medical treatment or euthanasia, or die. If an animal becomes sick, non-ambulatory, or dies, it is critical to protect the other animals from potential diseases and to provide special care for the sick or recovering animal. Management or dairy farms should be prepared to handle these conditions through proper employee training, segregation, and prompt decision-making to treat, marker, or euthanize an animal. To reduce the likelihood of transmitting disease, avoid going from sick animal facilities to healthy animal facilities.

**NUTRITION**  When an animal becomes sick or injured requiring separation from the herd for medical treatment (special needs animal), the recovery of that animal is enhanced through appropriate nutrition.

- Special needs animals are not restricted from feed and water for more than four hours.
- Special needs animals’ rations should provide the required nutrients for maintenance and growth and lactation for the appropriate physiological life-stage as found in references such as the National Research Council, 2001.

**ANIMAL HEALTH**  Prompt decisions and actions are necessary if an animal becomes non-ambulatory. The producer or person in charge must determine immediately whether the injured animal is otherwise healthy and can be nursed back to health or cannot be saved. If the non-ambulatory animal can be nursed back to health, protect it from further injury; provide it with shelter, food, and water; and give it care to minimize its pain and discomfort during the recovery process. The use of flotation tanks should be considered.

Euthanasia is appropriate when an animal’s quality of life is decreased or when pain and suffering cannot be alleviated. Dead animals, either euthanized or expired from natural causes, are potential sources of infection. They should be disposed of promptly by a commercial rendering service or other appropriate means (e.g., burial, composting, or incineration) in accordance with applicable ordinances.

- The dairy has a Herd Health Plan, developed in consultation with the herd veterinarian (or other knowledgeable professional such as cooperative extension agents), which includes specific areas for non-ambulatory animal management:
  - Proper movement to avoid dragging the animal.
  - Husbandry and nursing care that provides shelter, water, feed, isolation from other animals, and protection from predators.
  - Prompt medical care.
  - Euthanasia if warranted.
Chapter 9
Special Needs Animals

The dairy has a Herd Health Plan, developed in consultation with the herd veterinarian (or other knowledgeable professional such as cooperative extension agents), which includes specific protocols for euthanasia consistent with recommendations from the American Association of Bovine Practitioners.

- **Training of staff on the need for and recognition of animals to be euthanized.**
- **Designated employees trained in proper technique(s).**
- **Confirmation of death.**
- **Record keeping of euthanized animals.**
- **Disposal of carcasses in compliance with local regulations.**

**Housing and Facilities** A hospital or sick pen isolates the animal(s) from the herd and makes treatment easier; it is important that the pen be equipped to maximize animal comfort. It should provide adequate shade, bedding, air movement, and accessibility to feed and water.

- **Facilities are provided to segregate sick or injured animals.**
- **Self-locking stalls provide an emergency release for non-ambulatory animals when necessary.**

**Handling, Movement and Transportation** Non-ambulatory cattle that cannot be carried should be moved with an appropriate sled, sling, or bucket with the exception of cases where an animal must absolutely be moved a short distance before an appropriate movement aid can be used (e.g. if a cow becomes non-ambulatory in a parlor). Prevention, preparation, and prompt action are keys to their proper handling. A commitment to prevent animal injuries should include shipping promptly. Clearly defined policies requiring appropriate handling practices are established and followed, caretakers should be trained and supervised in proper animal handling, especially during parturition.

- **Timely and prompt marketing of animals is part of the management plan.**
- **Designated staff members have been trained and proper equipment is available to move downer animals.**
- **Special equipment for injured or non-ambulatory animals is available.**
- **Trained personnel are available when sick, injured, non-ambulatory, or dead animals must be moved.**
Chapter 10  Dairy Beef

Marketing a dairy animal as beef is an important part of dairy farming. A producer must ensure the appropriateness of transitioning a dairy animal to the beef sector.

The dairy uses the “Top 10 Considerations for Culling and Transporting Dairy Animals” in culling, handling, and transportation decision-making. (See Appendix G in the Animal Care Manual)

DAIRY BULL CALVES AND FREEMARTIN HEIFERS  All calves, whether to be raised as a replacement heifer, veal, or dairy steer, should receive colostrum or colostrum replacer and be fed in a way that promotes health and reduces the risk of disease. Please refer to Chapter 4 in the Animal Care Manual for additional information on newborn calf animal care practices.

Calves receive colostrum or colostrum replacer soon after birth.

Calves are fed milk or milk replacer until marketed.

If these calves are kept on farm after weaning, they should be fed rations that provide the required nutrients for maintenance and growth as found in references such as the National Research Council, 2001.

Calves have continuous access to fresh water or are provided water at least twice a day, or as needed to maintain proper hydration.

Chapter 11  Third-Party Verification

Proper animal care is an expectation of all participating producers. Through a statistical sampling, an appropriate number of dairy farms participating in the National Dairy FARM Program will be randomly selected for third-party verification. The third-party verification will be administered at the randomly selected sites, and is not intended to imply preference for those operations or give them permission to use the verification as an advantage over other operations.

As part of the National Dairy FARM Program, the evaluated farm will participate in the random statistical sampling third-party verification program.
To learn more about the National Dairy FARM Program, log on to
www.nationaldairyfarm.com

or call the National Milk Producers Federation at
(703) 243-6111.
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