PROCEEDINGS OF THE 50th
FLORIDA DAIRY PRODUCTION CONFERENCE
Alto Straughn IFAS Extension Professional Development Center
Gainesville • Florida • April 9, 2014

Sponsored by the Department of Animal Sciences, Florida Cooperative Extension Service and the Agricultural Experiment Station of the Institute of Food and Agricultural Sciences, with the cooperation of State Dairy Organizations and Allied Industry
MISSION STATEMENT
The mission of the Florida Dairy Production Conference is to create a program which brings together some of the newest research, innovations, recommendations and ideas for improving the sustainability and profitability of the Florida dairy industry. The presented information provides practical take-home messages for dairy farmers and highlights emerging trends in the primary dairy industry. The conference strives to provide a friendly learning and sharing atmosphere with networking opportunities for our target audience of dairy owners and employees, allied dairy industry professionals, students and dairy educators.

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Proceedings from past Florida Dairy Production Conferences are available at http://dairy.ifas.ufl.edu.
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50th Florida Dairy Production Conference - Schedule

Wednesday, April 9, 2014
Alto Straughn IFAS Extension Professional Development Center
Gainesville, Florida

9:00 AM  **Registration**
Presiding - Mary Sowerby, University of Florida

9:45  **Welcome and IFAS dairy update** - Geoffrey Dahl, University of Florida, Gainesville

10:00  **Avoiding the two greatest silage problems** - Adegbola Adesogan, University of Florida, Gainesville

10:50  **Goals for my program in udder health** - Corwin Nelson, University of Florida, Gainesville

11:10  **Management and training of dairy personnel: Emphasis on team work and performance** - Gustavo Schuenemann, The Ohio State University, Columbus

12:00 PM  **Luncheon**
Presiding - Jose Santos, University of Florida

1:00  **Goals for my program in rumen microbiology** - Tim Hackmann, University of Florida, Gainesville

1:20  **What does mom want to tell me? Colostrum and milk as a communication vehicle from the dam to the calf** - Mike Van Amburgh, Cornell University, Ithaca, NY

2:10  **Management opportunities for improving profitability of SE dairies: Where are the real dollars?** - Bruno Amaral, Purina Animal Nutrition, Jacksonville, FL

3:00  **Break**

3:30  **Producer’s view of staying ahead in the dairy business** - Calvin Moody, BrooksCo Farm, Quitman, GA

4:00  **Producer’s view of staying ahead in the dairy business** - Don Niles, Dairy Dreams LLC, Casco, WI

4:30  **Discussion: Staying ahead in the dairy business** - Moderator Jose Santos

5:00  **Reception** - Hors d’oeuvres, non-alcoholic beverages, wine and beer are available.
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Avoiding the Two Greatest Silage problems

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Introduction

The two greatest silage problems are shrinkage (dry matter losses) and heating (aerobic spoilage). Therefore, one of the main aims of silage making is to reduce losses of dry matter during the preservation process. Dry matter losses occur during the three main stages of silage preservation namely the aerobic respiration stage after cutting, the anaerobic fermentation stage after sealing, and the aerobic feedout stage after the silo is opened. Dry matter (DM) losses from silage range from 10% under good management to 40% under poor management and the financial implications are often ignored or underestimated. Bolsen and Bolsen (2012) described the magnitude of the problem. If corn silage is priced at $50/ton and 10% of the DM is lost during ensiling, the true value of the corn silage is $56/ton, but if 40% of the DM is lost, the true value of the corn silage is $83/ton. Also, if 40% of the 109 million tons of silage produced last year (USDA NASS, 2012) was lost to shrinkage, the value would be $2.2 billion at a cost of $50/ton, whereas it would be $600 million if shrinkage was 10%. These numbers emphasize the importance of minimizing DM losses during silage making.

Heating and spoilage during feedout is one of the greatest contributors to DM losses (Table 1). Spoilage occurs when yeasts and molds that were dormant during the fermentation begin to grow and oxidize nutrients into carbon-di-oxide and heat after they are exposure to oxygen in the air. In addition to increasing DM losses, Spoilage reduces silage quality. Feeding spoiled high-moisture shelled corn to dairy cows reduced milk production by 3.2 kg/d (Hoffman and Ocker, 1997). Feeding spoiled silage also reduced fiber digestibility and DM intake in cattle (Figure 1) and destroyed the rumen fiber mat (Bolsen and Bolsen, 2012). In addition, molds in spoiled silage may produce mycotoxins that can reduce the performance and health of cattle and cause serious health problems for producers.

Management recommendations to reduce silage spoilage and shrinkage

Silage spoilage increases as silage maturity and dryness increase. It is more difficult to pack the drier, harder stems of more mature forage in order to eliminate the air pockets that allow spoilage-causing molds to grow. Consequently, harvesting forages at the correct maturity stage can help to reduce DM losses, heating and spoilage. In the past, the recommendation was to harvest corn for silage at the 1/3 to ½ milk-line stage. This advice is no longer valid. Rather, corn and sorghum should be harvested when the DM is about 35%. To achieve this harvest stage, corn plants should be taken from representative parts of the field and chopped and dried to measure the DM content at least two weeks before the anticipated harvest dates. Monitoring the weather and DM content during this period will help to accurately predict when to harvest. In
the southeast, most grasses should be harvest as four to six-week regrowths for silage making depending on whether the aim is to maximize milk per ton or milk per acre.

Table 1. Dry matter losses in silage under good or poor management (Rankin, 2010)

<table>
<thead>
<tr>
<th>Source</th>
<th>Good</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiration</td>
<td>0-4%</td>
<td>10-15%</td>
</tr>
<tr>
<td>Fermentation</td>
<td>4-6%</td>
<td>10-15%</td>
</tr>
<tr>
<td>Seepage</td>
<td>0-2%</td>
<td>5-15%</td>
</tr>
<tr>
<td>Aerobic storage</td>
<td>5-7%</td>
<td>10-20%</td>
</tr>
<tr>
<td>Total</td>
<td>9-17%</td>
<td>20-40%</td>
</tr>
</tbody>
</table>

Drying should ideally be done using an oven. Microwave and Koster drying procedures may also be used but these are less accurate. More information on forage moisture determination methods is available at [http://pubs.ext.vt.edu/442/442-106/442-106_pdf.pdf](http://pubs.ext.vt.edu/442/442-106/442-106_pdf.pdf). Several real-time moisture estimation methods now exist which use capacitance, microwave or near infrared sensors. These allow estimation of the moisture of the forage from a digital display on choppers. Capacitance sensors are calibrated at specific forage densities therefore, they can be inaccurate if the density of the forage being packed differs from that used for the calibration (Digman and Shinners, 2008). Microwave and near infrared sensors are generally accurate if they are calibrated well and the lens is clean, undamaged and properly aligned with the intake of the forage into the chopper. Alternatively, hand-held near infrared sensors are also available. These are accurate but often expensive.

As shown in Figure 1, silage DM losses increase as silage density decreases. Therefore, whatever can be done to increase silage density is very important. Producers should use their heaviest tractor for packing and should pay serious attention to packing well at the side walls and the top layer. These areas are more likely to be less dense during packing. We recommended that producers should aim for a density of 15 lb/cu ft on a DM basis. A survey of the density at the center of over 40 corn silage bunkers revealed that the average density at the center was 13 lb/cu ft but it was only 10 lb/cu ft at the top (Visser, 2005). Based on the data in Figure 1, packing at 10 lb/cu ft instead of 15 lb/cu ft will increase DM losses by about 60%.

A recent concept about packing silage is that the density should be estimated on a wet weight basis rather than a dry weight basis. Voids or air pockets in the silage make it porous and the greater the voids, the more porous the silage is. This is because the voids serve as pathways that allow oxygen penetration into silos. Oxygen is what stimulates the growth of spoilage molds hence it is critical to minimize oxygen penetration and reduce silage porosity by increasing density. However, silage porosity increases as the silage gets drier, therefore, it is more accurate to measure silage density on a wet weight basis than on a dry basis. For corn
silage bunkers, producers should aim to achieve a wet or bulk density of 44 lb/cu ft. This allows producers to estimate silage density without calculating the moisture content.

In Figure 2, two suggested locations of coring locations on the silage face are shown. Either of these is acceptable. Ensure that corers are sharpened or serrated (teeth on the edges). Using high-torque, spiral assist or motor-driven corers can enhance the silage sampling process. When taking silage cores, it is essential to be safety conscious and always aware of the danger of silage avalanches. A much safer approach to estimating silage density is to use the spreadsheets available at the University of Wisconsin website at http://www.uwex.edu/ces/crops/uwforage/storage.htm. Click on ‘Bunker silo density calculator’ or ‘Pile silo density calculator’. You will need to enter details like your silo height, silage delivery rate, packing layer thickness, dry matter content, and the weight and percentage packing time for each tractor. An advantage of this approach is that it can be used for planning purposes before the silage is packed into the bunker and no corers are required. However, the accuracy of the result depends on the accuracy of the estimates entered into the spreadsheet. Another method of calculating silage density based on the weight and volume of silage removed during feedout is available but much less accurate (Norell et al., 2013). New methods of measuring silage density on choppers in real time using radiometry have been developed in Germany.

![Figure 1. Relationship of dry matter loss to density in corn silage.](image)
To minimize spoilage and heating after opening bunker silos, it is critical to feed the silage out an appropriate rate. Feedout rates of at least 6 inches a day are recommended and rates of 12 inches a day are preferred. To achieve these rates, the width of the bunker face or pile should not be excessive. It is often wiser to build bunkers or piles that are narrow rather than wide.

Using additives to reduce silage spoilage and shrinkage

Additives can be used to reduce DM losses and heating in silages, but an understanding of the efficacy and role of the different types is necessary to achieve desired improvements in silage preservation. The following section describes the main silage additives used in the US.

Organic acids

Adding organic acids rapidly acidifies forages thus inhibiting the growth of the Clostridia and Enterobacteria that increase DM losses and protein degradation during ensiling. Examples of such acids include propionic, benzoic, sorbic, and formic acids etc. In the US, propionic acid is probably the most widely used silage preservation acid because its' strong antifungal activity increases bunk life by inhibiting spoilage yeasts and molds. The undissociated form has the antifungal effect therefore, lower pH values increase the efficacy of the acid. When added at 1 to 2% of the forage fresh weight, propionic acid limits DM losses and increases bunk life but it is also corrosive. Buffered propionic acid (salts of the acid like ammonium propionate) is less corrosive and when applied at concentrations of 0.1 to 0.2%, it may not affect the fermentation but can improve the aerobic stability (Kung, 2000) though higher rates are often more effective. Propionic acid should be applied at the chopper to ensure uniform distribution throughout the forage. Applying propionic acid to a silo face is not recommended because the acid does not
penetrate far behind the silo face. Buffered propionic acid products cost about $10 -11/ton therefore they are more expensive than inoculants and should be used when quality silage is required from large acreages in a short period of time. Other acids like benzoic and sorbic acid are also effective mold and yeast inhibitors but due to their high cost, they are often sold in mixtures with propionic acid.

Acids are particularly useful if silage is made from wet silage. Drought stressed forage is usually wetter that it seems to be, therefore acid treatment may improve the preservation by rapid acidification which prevents clostridial proteolysis and butyric acid production.

**Ammonia and urea**

Ammonia is a strong alkaline which is very effective at increasing bunk life because it inhibits the growth of spoilage-causing organisms in silage. Applying ammonia also increases the crude protein concentration of silage and may increase the digestibility. The anhydrous form is best for uniformly applying ammonia to silage and it should be applied at 0.3 to 1% of forage DM. Ammonia poisoning may occur if ammonia is not uniformly distributed in the forage or if high rates are applied. A main challenge with ammonia is that it is a very caustic and hazardous when inhaled or if it contacts skin. Therefore, protective clothing must be worn when handling anhydrous ammonia. Ammonia may also prolong the fermentation and increase DM losses because its’ alkalinity buffers decreases in pH, therefore it is not ideal for forages with low sugar concentrations or high buffering capacities (Kaiser, 2004) or for drought stressed corn with high nitrate and or sugar concentrations. Use of ammonia for silage preservation has been limited by the inconsistent effects on animal performance (Kaiser, 2004), the potential fermentation restriction, the hazardous nature and high price of ammonia.

In the presence of adequate moisture, urea can be used as a forage preservative because it can be hydrolyzed into ammonia by urease enzymes on plants. Urea is safer to handle and apply than ammonia but to avoid toxicity problems, urea should be dissolved in water and uniformly mixed in the forage. Silages treated with ammonia or urea will have high soluble N concentrations and care should be taken to ensure degradable and undegradable protein requirements of the cow are met when such forages are fed (Kung, 2000).

**Enzymes**

Enzymes added to silage include amylase for degrading starch into sugars and cellulases or xylanases for degrading cell walls into sugars. Sugars released by the enzymes enhance the growth of silage bacteria and in some cases, fiber degrading enzymes also increase forage digestibility. Such enzymes are usually more effective on cereal silages and immature cool season grasses than on mature cool season grasses, legumes, or warm season grasses, which are more lignified. Nevertheless, Dean et al. (2005) showed that when applied at ensiling to bermudagrass silage, a fiber digesting enzyme reduced the pH and DM losses and increased fiber hydrolysis into sugars, reduced protein degradation to ammonia and increased aerobic stability. Three other enzymes tested in the study had only some of these beneficial effects. These different responses to enzyme treatment reflect the inconsistent responses to enzyme treatment of forages or total mixed rations in the literature. Kung and Muck (1997) reported that enzyme treatment increased liveweight gain, milk production and feed efficiency in 40, 33, and 27 % of
39 studies. This inconsistency is partly because enzymes differ considerably in their main activities, application rates, and microbial sources. Also, the optimal temperature (122 to 140°F) and pH (4-5) for many commercial enzymes are greater than those in well-made silages. Lastly, low enzyme application rates are often used due to high enzyme costs. Recent technological advances in enzyme use by the biofuel industry may reduce enzyme costs in the future.

Enzymes are sometimes added to bacterial inoculants to degrade cell walls and increase the availability of sugars used as growth substrates by the inoculant bacteria. This approach has sometimes resulted in improved fermentation and or improved forage digestibility. Queiroz et al. (2012) showed that disease infestation reduced the NDF digestibility and fermentation of corn silage but a mixture of an inoculant and enzymes reversed these negative trends.

**Inoculants**

Inoculants are added to silage to dominate the epiphytic (natural) population of bacteria on plants that cause DM losses by inefficient fermentation of sugars. Three main types of inoculants are currently used.

**Homofermentative bacterial inoculants**: Homofermentative bacteria have been used to increase forage acidification and minimize DM losses for several decades. Rapid acidification is achieved by fermentation of plant sugars into lactic acid. This represents the most efficient type of fermentation because it avoids or minimizes DM and energy losses by preventing the growth of bacteria that cause such losses. The main bacteria used in such inoculants are Lactobacillus plantarum or acidilacti, Pediococcus pentosaceus or acidilacti and Enterococcus faecium. Pediococcus and Enterococcus spp. grow more vigorously at high pH than L. plantarum and may be more tolerant of residual oxygen in the silo. Consequently, some inoculants contain Pediococcus and or Enterococcus spp. to ‘jump start’ the fermentation as well as L. plantarum for subsequent prolonged domination of the epiphytic bacteria. Homofermentative inoculants are particularly useful for improving the preservation of legumes like alfalfa and warm season forages with high buffering capacities and or low sugar concentrations. These inoculants typically reduce DM losses by about 2-3% and they increased DM intake, liveweight gain and milk production in 31, 53 and 47% of 39 studies reviewed by Kung and Muck (1997). They often cost $0.5 to $1.50, therefore, with a 2-3% reduction in DM losses and potential improvements in animal performance, they produce an economical response particularly with high silage costs of $50/ton or more.

In some cases, adding homolactic inoculants has reduced bunk life because the lactic acid they produce is used as a growth substrate by yeasts that initiate spoilage. Kung and Muck (1997) showed that inoculants (mostly homofermentative) improved bunk life in a third of studies, had no effect in another third, and reduced bunk life in a third of studies. Consequently, heterofermentative inoculants that increase bunk life by producing strong antifungal compounds during ensiling are preferred for improving bunk life.

**Heterofermentative inoculants**

These bacteria ferment sugars into lactic acid, acetic acid and or ethanol in a fermentation that is often less efficient than that of homofermentative bacteria. Consequently, DM losses are
greater when they are applied, but their beneficial effects on bunk life often outweigh the increased DM losses. Lactobacillus buchneri is perhaps the most widely used of these inoculants. It is added to silage because the acetic acid it produces during the fermentation has a strong inhibitory effect on the growth of spoilage yeasts and molds. Kleinschmit and Kung (2006) conducted a meta analysis on data from 23 studies and showed that application of L. buchneri to corn silage increased acetic acid production, reduced yeast counts and increased bunk life when applied at $10^5$ cfu/g and responses were greater when it was applied at $10^6$ cfu/g. Also, DM losses were 2 percentage units greater in L. buchneri-treated silages than in the Control silage but the improvement in bunk life outweighed these losses.

Adding L. buchneri to corn silages has improved bunk life in several farm-scale studies (Arriola et al., 2011, Mari et al., 2011) but no feed intake or milk production responses occurred when the treated silage was fed (Driehuis et al., 1999; Taylor et al., 2002; Kristensen et al., 2010; Arriola et al., 2011). In contrast, L. buchneri treatment of alfalfa silage has increased the bunk life of a total mixed ration and increased milk production in one study (Kung et al., 2003). Lactobacillus buchneri inoculants typically cost $1.50 to 2/ton. They are particularly cost effective in silages that are likely to heat such as corn and small grain silages and high DM forages. They are also likely to be effective in drought-stressed corn plants, which usually have high sugar concentrations that could enhance the growth of spoilage yeasts (Weiss, 2012).

**Combo inoculants**

Combo inoculants contain a mixture of homofermentative bacteria that reduce DM losses and heterofermentative bacteria that increase bunk life. In several studies, such inoculants have improved the bunk life of silages without increasing DM losses. Queiroz et al. (2012a) showed that a combo inoculant reduced the amount of spoiled silage and nutrient losses from corn silage by about 50% relative to the untreated control. Few studies have examined effects of such inoculants on animal performance. Arriola et al. (2011) reported that applying a combo inoculant containing P. pentosaceus and L. buchneri to corn silage did not improve the performance of dairy cows. Nevertheless, certain combo inoculants have been associated with other benefits including inhibition of mycotoxin production in diseased (Queiroz et al., 2012b) or damaged (Teller, 2012) corn plants and they inhibited the growth of E. coli O157 H7 when the pathogen was added to aerobically exposed corn silage (Pedroso et al., 2010).

**Using and choosing inoculants**

Inoculants should be stored in a cool, dry area after mixing with unchlorinated water and used within 24 hours to maintain the viability of the bacteria. To ensure uniform distribution in the forage, liquid inoculants are preferred and they should be applied at the chopper at the rate and for the forage stated on the label. The most effective products have at least 100,000 cfu/g or 90 billion live bacteria per ton.

**Summary**

Shrinkage and heating or spoilage are the two greatest silage problems. Proper management can prevent these problems. Additives will not overcome bad management, in fact excellent
management may improve additive effects. The following questions should be used to choose additives:

1) Is my goal reducing shrinkage, heating or both? To reduce shrinkage, use a homolactic inoculant. To increase bunk life, use an L. buchneri inoculant or a propionic acid additive.

2) Have independent research trials demonstrated the efficacy of the product at reducing DM losses or increasing bunk life or animal performance?

3) Does the product give at least a two to one economic return?

**Literature cited**


Mastitis in dairy cattle continues to be a major economic burden to dairy producers and negatively impacts milk safety and milk quality. Here in Florida, nearly 40 percent of bulk tank samples had SCC over 400,000/mL in 2012; signifying the prominence of mastitis in Florida. The overall cost of mastitis can be $250 - $350 per case, so substantial economic gains can be made from decreasing the incidence of mastitis. Proper hygiene, milking routine, and immunity are extremely critical for maintaining udder health. The main goal of my research is to minimize the impact of infectious diseases, such as mastitis, in livestock through understanding how genetic and environmental factors influence the immune system.

My research concentrates on the influence and regulation of vitamin D signaling in the immune system. Previous studies with an experimental model of mastitis in dairy cattle have revealed that the vitamin D pathway is activated in the udder in response to bacterial infection and ultimately functions to improve resistance to bacterial infection. In this pathway, the active vitamin D hormone, 1,25-dihydroxyvitamin D, is produced by in macrophages in the udder. The 1,25-dihydroxyvitamin D produced in the bovine macrophage acts in immune cells in the udder to improve host defense and limit inflammation. The main objectives of my current research are to 1) identify targets of the vitamin D hormone and the physiological significance of those targets in the immune system, and 2) identify the genetic, epigenetic and environmental (i.e. nutritional and pathogen) influences on vitamin D metabolism and the molecular basis of those influences.

We have recently discovered that 1,25-dihydroxyvitamin D increases expression of several beta-defensin antimicrobial peptide genes by 5-10 fold in macrophages of cattle. Beta-defensin antimicrobial peptides have potent bactericidal activity against gram-positive and gram-negative pathogens. At high concentrations, these peptides kill bacteria by piercing holes in the bacterial cell wall. They are a critical component of the cow’s innate defense system, but their presence in the udder is weak during mastitis. Taking advantage of the influence of vitamin D signaling on the defensins may give the innate defenses of the udder the boost it needs to defend against mastitis pathogens.

In addition to the implications of this research in udder health, the actions of vitamin D in the immune system have significant implications for animal health in general. For instance, dairy calves fed waste milk without adequate supplemental vitamin D are vitamin D insufficient, which may impair their immune system. Also, the ability of the vitamin D hormone to suppress inflammation and improve host defense allows for the potential of alternative preventative and therapeutic strategies. My hope is that my research efforts will minimize the burden of infectious diseases in cattle, specifically mastitis, so that production efficiency and profitability of dairy herds can be improved.
Management and Training of Dairy Personnel with Emphasis on Team Work and Performance

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Abstract

It is well known that transition cow diseases negatively affect reproductive performance; thus, profitability and welfare of dairy herds. Prevention of diseases at the herd level requires a constant effort and effective coordination of the total system (animals, environment, nutrition, and personnel). Substantial knowledge exists to prevent many diseases or conditions; however, it must be translated into on-farm applications or practices to have a meaningful effect at the herd level. Reproductive data of dairy herds throughout the United States showed that more than 73% of the variation in pregnancy risk (between bottom 10% and top 10% of herds) was due to management practices and/or environment. Fully trained and competent workers know what to do and how to do it, and have the skills and abilities to do the work. However, competent workers will often fail to perform when conflict or lack of satisfaction, motivation, and/or communication occur; resulting in lower work performance which affects the overall herd productivity. Frequent assessment of performance, educational needs, and training of dairy personnel should be top priorities for dairy operations to achieve a consistent and efficient herd performance over time. Practicing veterinarians regularly visit their clients and are ideally placed to identify at-risk dairy herds likely to benefit from personnel training (e.g., calving management), conflict management, and development of preventive SOPs.

Introduction

It is well known that transition cow diseases negatively affect reproductive performance; thus, profitability and welfare of dairy herds. The risk factors affecting dairy herd performance are multi-factorial and managerial in nature. Inadequate nutrition, cow comfort, udder health, heat stress, reproductive strategies, and AI technique negatively impact reproductive performance in dairy operations. Furthermore, calving-related losses such as stillbirth and uterine diseases (e.g., metritis) have been associated with management practices prior to and at calving and reduced reproductive performance. Poorly designed facilities (e.g., stalls, flooring) and high stocking density (>100%) affected resting time and ruminating, consequently, cows are at increased risk of developing hoof lesions and the subsequent suppression of estrous behavior and reduced reproductive efficiency.

Prevention of diseases at the herd level requires a constant effort and effective coordination of the total system (animals, environment, and personnel; Figure 1). Substantial knowledge exists to prevent many diseases or conditions; however, it must be translated into on-farm applications or practices to have a meaningful effect at the herd level. Transition-related losses (e.g., stillbirth, reproductive performance, milk yield) and welfare practices have become
known challenges for the dairy industry worldwide, and management practices within-herd prior
to and after calving have been associated with these problems.

Considering the complexity of a dairy production system, the objectives of the present
article were: 1) to identify approaches for best work team performance; 2) to identify strategies
to improve dairy personnel performance (knowledge, skills, and attitude); and 3) to identify and
rank within-herd risk factors to prevent calving-related losses while improving herd productivity
and welfare. Case-based examples were provided to highlight the importance of management
practices delivered by dairy personnel on the overall herd performance.

![Figure 1. Interaction of dairy personnel with components of an integrated production system
(animals, facilities/equipment, environment, and nutrition).](image)

**What makes a good team?**

In addition to regular full-time managers, many dairy operations are using advisory teams
(veterinarians, nutritionists, consultants; Figure 2) as a critical management tool to improve
personnel performance, communicate strategies, resolve problems and conflicts, review or
implement new protocols, and enhance decision-making (financial, feed inventory, herd health
performance). For effective teamwork and optimum herd performance, concepts about team
building and development were discussed.

Clutterbuck defined team as a small number of people with complementary skills who
are committed to a common purpose, performing goals, and approaches, for which they hold
themselves mutually accountable. A work team was defined as small groups of interdependent
individuals who share responsibility for outcomes of their organization. All people associated
with a dairy farm can be considered as part of a team (i.e., owners, managers, workers,
veterinarians, nutritionists, consultants, etc.); however, the dairy farm is made up of one or
several work teams depending on the size of the operation (Figure 2). The focus for effectiveness should be placed on the work team because those in separate work teams within the operation, while committed to a common purpose or goal, do not necessarily share responsibility for outcomes. For example, a work team of those responsible for making hay or planting and harvesting crops has different outcomes than the work team in the milking parlor, pariparturient cows, or those feeding lactating cows.

The following example illustrates the work teams, tasks, and interconnections (Figure 2): a large, family-owned dairy operation is managed by one herd manager, which oversees 31 dairy personnel distributed in 9 areas of the production system. Each of the 9 areas is led by one section manager. An external advisory team formed of three professionals (herd veterinarian, nutritionist, and accountant) are responsible for overall financial information (e.g., cost of production, feed-cow inventory, and replacements); herd health and nutrition recommendations, monitoring and interpretation of data; and training of personnel. The cow-labor ratio is approximately 143:1. In this example, all people associated with the farm are considered part of the overall team, but as seen in figure 2, there are actually 7 functional work teams within the farm (milking, cow pusher and clean stall, pre-partum and calving, fresh cows and hospital, reproduction, feeding, and maintenance) and 2 individual tasks (hoof trimming and record-keeping). It is important for owners, managers, and/or advisory teams to recognize these distinctions and manage task assignments, communication, and training accordingly.

**Figure 2.** Organizational scheme of dairy herd with an estimated 5000 cows. The scheme shows the work teams assigned to manage milk and dry cows on a day-to-day basis. Additional work teams for crops-pastures (planting, harvesting) and replacement heifers are not shown

**How to build effective teams?** – Building effective teams requires: 1) top-level commitment and specific, clear, and agreed upon goals; 2) trust and involvement between manager and employee; 3) willingness to take risks and share information; and 4) time, resources, and commitment to training. It is critical that herd managers or owners spend quality time finding the right task for the right worker and matching responsibilities with appropriate work team. Using tests of knowledge and observation through hands-on demonstrations serve as valuable instruments to
help identify those participants that are skilled and able to follow the on-farm standard operating procedures (SOP). When building a work team for calving management, managers should focus on selecting competent and meticulous personnel that share similarities (able to closely follow SOPs, practice good record-keeping, pay attention to details) to maximize the potential for team work and performance. Additionally, building on employees’ strengths and managing their weaknesses allow managers to achieve high personnel performance (Tables 1-2). In dairy farms, the owners and/or managers have greater authority and power in making decisions; therefore, they should assemble the work teams based on individual strengths and weakness by grouping personnel with complementary knowledge and skills.

**What makes a team effective?** – The following six characteristics of effective teams are critical to achieve high dairy personnel performance (adapted from Hackman and Levi): 1) clear directions (established SOPs) and objectives used to focus team’s efforts; 2) open communication practices and routinely monitor/discuss personnel performance; 3) skillful herd managers that facilitate team interactions and assist individuals when problems or conflicts occur; 4) skillful managers that can execute day-to-day tasks; 5) appropriate resources and equipment/facilities to perform the tasks; and 6) create a trusted and respectful working environment to allow team members to implement decisions. The use of established SOPs and hands-on training for work team members will likely improve personnel performance and ensures all workers understand the tasks; thus, achieving consistent herd performance and outcomes over time. Managers need to make sure that workers correctly understand the task and properly implement the SOPs by practicing open communication and allow workers to ask questions for further clarification (Table 1). Those who do not fully understand the task or are fearful of questioning will return to work, but fail to properly implement the SOPs (Table 1). Therefore, herd performance will likely suffer because of poor implementation of SOPs.

**Do workers know and understand the purpose of the team?** – Dairy personnel should be familiar with the purpose of the team: 1) why it exists, 2) how it relates to the overall farm strategy, 3) to whom it is responsible, and 4) how it will benefit the farm. Under field conditions, an effective team worker shares the following qualities (adapted from Brounstein): 1) demonstrates reliability, 2) communicates constructively, 3) listens actively, 4) functions as an active participant, 5) shares information openly and willingly, 6) shows commitment to the team, 7) works as a problem-solver, and 8) treats others in a respectful and supportive manner. In practice, dairy personnel should know and understand their role and purpose and why it is important.

**How do we identify the right people for the right job?**

Finding well-qualified workers is a challenging task for dairy farmers and it is very painful to lose them. Identifying cows in need of calving assistance, following the proper milking routine procedure, and consistent delivery of TMR, among others, are critical tasks (Figure 2) that require well-trained workers and established SOPs for optimal outcomes. Practicing veterinarians regularly visit their clients and are ideally placed to identify at-risk dairy herds likely to benefit from personnel training (e.g., calving management) and development of SOPs.
Table 1. Effect of two dairy herd manager styles on the effectiveness of communication, implementation of task following SOP, and turn-over of personnel.

<table>
<thead>
<tr>
<th>Manager Styles‡</th>
<th>Manager Communication of task</th>
<th>Dairy Personnel Implementation of task following SOP</th>
<th>Turnover</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tolerates wide range of personality styles, accepts and manages errors, calm but firm on decisions, and always rewards/acknowledges success†</td>
<td>Yes</td>
<td>More likely</td>
<td>Less likely</td>
</tr>
<tr>
<td>Does not tolerate wide range of personality styles or accept errors without consequences, often overreacts on decisions, and seldom rewards/acknowledges success*</td>
<td>Yes</td>
<td>Depends on interpretation of the task at the time of communication</td>
<td>More likely</td>
</tr>
</tbody>
</table>

‡The manager styles illustrate two different management approaches to execute on a day-to-day basis standard operating procedures (SOP) at the herd level.
†This description represents a herd manager that focuses on active listening, interact with workers on a daily basis, and anticipate and/or solve personnel issues.
*This description represents a herd manager that uses a “no questions” or “do what I say” approach, focuses on task execution, interact with workers on a daily basis, and prefer new workers as opposed to manage personnel issues.

Personnel knowledge, skills, and attitude - It is critical that herd managers or owners spend quality time finding the right task for the right worker. This is perhaps the most important task when building effective work teams within dairy operations for consistent outcomes over time. For calving management personnel, characteristics such as attention to details (able to follow the established SOP), knowledge level, and skills were significantly associated with stillbirth. However, the assessment of attention to details requires close observation and monitoring of personnel by the herd manager or trainer. Training schools for dairy personnel is a critical management tool and the use of tests of knowledge (pre- and post-tests) and supervised hands-on training provide a metric to assess personnel’s level of knowledge, skills, and meticulousness. It is important to note that calving personnel need sufficient time to practice and gain confidence (learning-by-doing approach) to successfully apply the newly learned skills within their context or systems. Fully trained and competent workers know what to do and how to do it, and have the skills and abilities to do the work; however, competent workers will often fail to perform if they have poor attitude due to conflict, lack of satisfaction, motivation, or communication (Table 2). Poor attitude results in lower work performance, affecting the overall herd performance.
Table 2. Effect of on-farm problems/issues at the time of training on dairy personnel knowledge, skills, and performance.

<table>
<thead>
<tr>
<th>Parameter Assessed</th>
<th>On-Farm Problem/Issue(^5)</th>
<th>(\text{Yes})</th>
<th>(\text{No})</th>
<th>(P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge(^1), %</td>
<td>19</td>
<td>21</td>
<td>&gt;0.05</td>
<td></td>
</tr>
<tr>
<td>Skills(^2), %</td>
<td>32</td>
<td>35</td>
<td>&gt;0.05</td>
<td></td>
</tr>
<tr>
<td>Performance(^3), %</td>
<td>4</td>
<td>23</td>
<td>&lt;0.05</td>
<td></td>
</tr>
</tbody>
</table>

\(^1\)Percentage points increase in knowledge gain by dairy personnel between pre- and post-test scores during a calving management workshop.
\(^2\)Percentage points increase in dairy personnel skills after calving management or milking routine training.
\(^3\)Percentage points increase in dairy personnel performance after calving management or milking routine training.
\(^5\)On-farm problem/issue was defined as self-reported conflict, lack of communication, disrespect, etc. with herd manager or co-worker by dairy personnel.

Although on-farm SOPs are essential management tools for modern dairy operations that summarize critical information or steps involved in a particular task or procedure (e.g., management of dystocic births, TMR, milking routine), they should not be used as the only source of information for dairy personnel. Learning from a set of descriptive bullets, as in most SOPs, carries a real risk for mistakes because calving personnel might not understand the whole process. For instance, dairy personnel attending a calving training workshop shared examples of unclear recommendations such as “wait 2 hours and assist cows experiencing difficult births” or “if there is no calving progress call for help”.\(^4\) The SOP for calving management must provide clear reference landmarks for time zero (when to start counting) and signs of the normal progression of calving; otherwise, most calving personnel would not be able to correctly follow the above recommendations.

Tracking personnel performance and turnover – Frequent assessment of performance, educational needs, and training of dairy personnel should be top priorities for dairy operations to achieve a consistent and efficient herd performance. It is common to observe large within-herd variation in milking personnel performance (MPP) and turnover (TO) over time. Assessing team performance, resolution of conflicts, and comprehensive training of dairy personnel are critical management tasks to achieve consistent performance in dairy herds (Table 1). One of the positive aspects about turnover is that it provides opportunities for remaining team members to increase or change responsibilities. Some herds keep a multi skilled person(s) who serves as the trainer and is readily available, not allocated to any specific mandatory daily role on the farm, which can be used to plug the gaps caused by absentees to help maintain productivity levels. This person could assist training new employees, has flexibility in everyday responsibilities to fill in for absentees, and keeps busy when fully staffed by helping wherever needed to increase overall productivity.
Recently, the effect of MPP (95% vs 85%) and TO of personnel (5% vs 30%) on milk losses of dairy herds were assessed.\textsuperscript{3,4} For the simulation, the performance of each worker (compliance with milking routine protocol) was set to 85% or 95%. Milk losses were set at 1 kg/cow/day due to lack of udder stimulation (cows at risk).\textsuperscript{31} An adjustment period of 14 days with a 66.5% performance was estimated for each new worker. The overall risk performance (%; RP) was estimated taking into account the team milking performance and TO. The number of cows at risk (cows/day) was estimated based on the RP (10 workers) and herd size (2000 cows). Milk price was set at $0.41/kg. Costs for herd audit were set at $1000 and training program at $1000 (for 4 sessions per year). Milk losses ($/year/cow) and return on investment (ROI) were estimated. For this analysis, losses associated with the time and resources spent in recruitment, selection, and hiring as well as the orientation and initial training of new personnel were not included.\textsuperscript{5,6}

For a 2000-cow herd, the overall effect of TO (5% vs 30%) on milk losses was $6744 while the overall effect of RP (85% vs 95%) on milk losses was $27920. Cows at risk and milk losses were higher ($14 per cow/year) for RP 85% with 30% TO (342 cows/day) compared with RP 95% with 5% TO (110 cows/day). The ROI for high performance teams (RP 95% and 5% TO) was $18 for every $1 invested (herd audit and training). The estimated ROI assumes that equipment/facilities are adequate, participants are willing to learn and apply the newly learned concepts, and the herd audit correctly identifies the needs. These findings suggest that both TO and RP affect the bottom line of dairy herds.

### How Can We Help Farmers Prioritize Challenges on the Farm?

The use of defined events (e.g., stillbirth, metritis, retained fetal membranes, lameness) should be perhaps the first step to prevent transition cow problems under field conditions. It is very difficult to manage what cannot be measured and incorrect or missing data often leads to erroneous conclusions or management decisions. Many factors influence the reproductive and productive performance of dairy herds; thus, profitability. For instance, it is common to observe large between herd variation in pregnancy risk (PR) of lactating dairy cows. Reproductive data from 8,211 dairy herds obtained from the Dairy Records and Management Systems in 2010 across the United States were used to estimate the mean 21-day PR and weighted averages (considering the number of herds and PR) for the bottom 10% and top 10% of herds. It was estimated an 8% PR for the bottom 10% of herds and 26% PR for the top 10% of herds with a mean PR of 16%. Furthermore, using a subset of 50 dairy herds, it was estimated that >73% of the variation in PR was due to management practices and/or environment. Successful identification of factors affecting reproductive performance at herd level can be challenging due to their multi-factorial nature. A herd assessment tool was developed to assess the overall herd performance taking into account personnel performance and their management practices.\textsuperscript{3,4} The instrument ranks risk factors affecting herd performance such as stillbirth, retained fetal membranes, metritis, mastitis, lameness, body condition score, estrus detection, conception risk, cow-labor ratio, stocking density among others. This tool uses as inputs the actual herd data (from records or walk-through observation) and as outputs the ranking of risk factors affecting performance (e.g., PR, stillbirth, personnel).

Veterinarians often trouble-shoot poor reproductive performance in dairy herds, but this process requires constant monitoring and comprehensive assessment of several events. Because
the herd management varies greatly from farm-to-farm, ranking of within-herd risk factors with
greater contribution weights (e.g., stocking density, training) on PR is critical to implement
corrective, step-by-step management strategies. Using data from one dairy herd previously
assisted to improve PR (from 19% to 23%), the effectiveness of a herd assessment tool to aid in
decision making about reproductive performance of dairy cows was assessed. Risk factors
[stillbirth, retained fetal membranes (RFM), metritis, mastitis, lameness, body condition score
(BCS), estrus detection (ED), conception risk (CR), cow-labor ratio, and stocking density] were
assessed according to their contribution weights on PR. Additionally, risk factors (one year
before and after intervention) were compared with desired reference values to obtain the ranking
of risk factors. According to the herd assessment tool, stocking density; metritis; lameness; and
stillbirth were the top four risk factors explaining PR before intervention. Recommendations
were close-up pen for dry cows; 85% stocking density for close-up and fresh cows;
comprehensive training (calving management and hoof trimming) to dairy personnel; and no
changes were made on nutrition and reproductive management. After intervention, the relative
difference (change of risk factor values) was improved for stillbirth (45%), lameness (46%),
metritis (33%), stocking density (13%), and mastitis (13%). No changes were observed for RFM
(0%), BCS (0%), and cow-labor ratio (0%) while the relative differences for ED (3%) and CR
(6%) were decreased after intervention.

Conclusion

Decision support tools that combine sound biological knowledge of cows with the
assessment of several factors affecting directly or indirectly a specific area of the production
system will likely allow herd managers and veterinarians to identify and rank the risk factors in a
priority order. Every dairy farm is an integrated system and decisions made on one area of the
farm will have an impact on other areas of the farm. Frequent assessment of performance,
educational needs, and training of dairy personnel should be top priorities for dairy operations to
achieve a consistent and efficient herd performance over time. Risk assessments could assist
decision makers in focusing on real within-herd risk factors accounting for the effect of
management and work team performance.

Acknowledgements

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that attended the Ohio Dairy Health and Management Certificate Program.

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Goals for My Program in Rumen Microbiology

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Though hidden from view, the rumen and its microbes hold a central role in feeding of cattle. During fermentation, microbes break down fiber and other feed components and produce VFA. In this process, microbes harvest energy from feed, then harness part of this energy to produce microbial protein. Volatile fatty acids so produced meet up to 70% of the animal’s energy needs, and microbial protein meets 60 to 85% or more of protein needs.

Microbes may be essential to cattle, but they charge a fee for their services. Microbial fermentation causes 4% of feed (gross) energy to be lost as heat, and methane production from methanogens causes an additional 2 to 12% loss. My goal is to make microbes spend those fees more efficiently, or at least better predict how wasteful they will be.

At present, microbes are not particularly efficient with the energy they harvest from fermentation; they may use as little as 1/3 for production of microbial protein (cellular growth). My lab tries to understand how the remaining energy is “wasted” on functions other than protein production. If we could re-route even part of this wasted energy, we could increase microbial protein and decrease need for expensive feed protein.

We have found when given large amounts of excess energy, rumen microbes can waste energy by simply burn off the excess energy as heat, in a process known as energy spilling. When given smaller amounts, microbes can stored much of the energy, but storage itself requires an irreversible expenditure of energy. We are now trying to identify which microbes store energy by tagging their energy reserves with a fluorescent compound, and in the future, we may be able to identify microbes that spill energy. In the more distant future, we may be able to direct manipulate microbial populations—such as with vaccines—to eliminate the most wasteful microbes.

Even if we cannot reduce waste, we may be able to develop better diet formulation software to predict the magnitude of this waste. Such improved software would enable less protein to be fed safely. As mentioned, rumen microbes flowing from the rumen supply most protein digested by cattle. Diet formulation software predicts the size of that microbial protein supply, but it often does so inaccurately because it does not account for waste explicitly. With data we will generate, we can represent the waste more explicitly and improve predictions of diet formulation software, increasing confidence in predictions. It is my long-term goal to release this improved diet formulation software to dairy producers and allied industry in Florida and around the globe. This will help dairy producers feed better and more cost-effective rations.
NOTES
Early Life Nutrition and Management Impacts Long-Term Productivity of Calves

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**Take home messages**

1. The pre-weaning period is a period of life where the calf is undergoing significant developmental changes and this development is directly linked to future productivity in the first and subsequent lactations.
2. Pre-weaning growth rate and primarily protein accretion appears to be a key factor in signaling the tissue or communication process that enhances life-time milk yield.
3. Anything that detracts from feed intake and subsequent pre-weaning growth rate reduces the opportunity for enhanced milk yield as an adult.
4. Nutrient supply, both energy and protein are important and protein quality and digestibility are essential.
5. There are no substitutes for liquid feed prior to weaning that will enhance the effect on long-term productivity.
6. Factors other than immunoglobulins in colostrum modify feed intake, feed efficiency and growth of calves and can enhance the effect of early life nutrient status.
7. As an industry and as nutritionists we need to talk about metabolizable energy and protein intake and status relative to maintenance and stop talking about liters, kilograms and grams of dry matter, milk, milk replacer etc. The calf has discrete nutrient requirements not related to dry matter and liquid volume measurements.
8. The effect of nurture is many times greater than nature and the pre-weaning period is a phase of development where the productivity of the calf can be modified to enhance the animal’s genetic potential.

**Lactocrine hypothesis**

The concept of a “lactocrine hypothesis” has been recently introduced and describes the effect of milk-born factors, including colostrum in this definition, on the epigenetic development of specific tissues or physiological functions (Bartol et al., 2008). Conceptually this topic is not new but the terminology is useful and the ability of several groups to make a direct connection from a milk-born factor to a developmental function at the tissue or behavior level is significant (Nusser and Frawley, 1997; Hinde and Capitanio, 2010). Data relating to this topic has been described and discussed by others in neonatal pigs (Donovan and Odle, 1994; Burrin et al., 1997) and calves (Baumrucker and Blum, 1993; Blum and Hammon, 2000; Rauprich et al. 2000). The implication of this hypothesis and these observations are that the neonate can be programmed maternally and post-natally to alter development of a particular process. It is not well understood if the lactation response is a function of total nutrient intake or if there are factors in whole milk that are responsible for the developmental function. In primates, Hinde and Capitanio (2010) were able to demonstrate that maternal milk composition and yield impacted...
offspring behavior, which has implications for the dairy industry and early life human health and development.

In calves the effects of suckling, controlled intakes and *ad-libitum* feeding of calves from birth up to 56 days of life have found that increasing the nutrient intake prior to 56 days of life from milk resulted in increased milk yield during first lactation ranging from 450 to 1,300 kg compared to the milk yield of restricted fed calves during the same period (Foldager and Krohn, 1994; Bar-Peled et al, 1997; Shamay et al., 2005; Terré et al., 2009; Moallem et al. 2010; Soberon et al., 2012). In Moallem et al., (2010), the effects of pre-weaning nutrition on long term productivity were associated with the type and quality of nutrients fed. Moallem et al. (2010) observed significantly (10.3%) higher milk yields during first lactation from heifers fed whole milk *ad-libitum* compared to heifers fed milk replacer *ad-libitum* during the same period and suggested that milk replacer did not contain the same biologically active factors as milk and thus did not impart any lactocrine effects on the calves. However, the data of Soberon et al. (2012) and others suggest that the long-term effect is related to nutrient intake and pre-weaning growth rates and not some milk-born factor. A review of the studies conducted to date would suggest that the long-term milk response is related to protein synthesis, thus energy intake above maintenance coupled with adequate protein and amino acids are essential for the signaling mechanism important for long-term changes in productivity. Any signals from colostrum would only enhance this observation.

**Colostrum’s role**

Colostrum is known to be rich in a variety of molecules (ratio of colostrum composition to mature milk composition), including relaxin (>19:1 pig), prolactin (18:1 cow), insulin (65:1 cow), IGF-1 (155:1 cow), IGF-2 (7:1 cow), and leptin (90:1 humans) (Odle et al., 1996; Blum and Hammon, 2000; Wolinski et al., 2005; Bartol et al., 2008).

Colostrum is well known to have major effects on the development of the gastrointestinal tract for a long period of time, but the exact mechanisms are still not well understood. During the first few days of life in neonatal piglets, a notable increase in the length, mass, DNA content, and enzymatic activities of certain enzymes (lactase) occur in the small intestine for neonates fed colostrum/milk versus a control of water (Widdowson et al. 1976, Burrin et al., 1994). This was originally thought to be mediated by differences in nutrient intake between milk and water (Burrin et al. 1992), however other studies have demonstrated differences between animals fed colostrum, rich in growth factors, versus milk with comparable energy values (Burrin et al., 1995). Although there are studies that don’t agree with Burrin et al., (1995) and continue to promote nutrient intake as the driving factor (Ulshen et al., 1991), there is potential for non-nutrient factors to play a major role in the development of the gastrointestinal tract.

Further, Burrin et al. (1995) examined the effects of feeding colostrum, mature milk, formula (similar macronutrient composition to colostrum), and water on circulating metabolites and protein synthesis in piglets. The most significant finding was that the increased rate of protein synthesis in skeletal and jejunal protein synthesis of colostrum fed calves versus the other groups, although blood metabolite concentrations, including insulin, were not different. This is significant because it suggests other factors other than nutrient intake induced gastrointestinal and protein synthesis changes in the neonatal piglet. The group speculated that the reason for
increased protein synthesis, regardless of treatment, was due to high circulating insulin levels postprandial during the first 6 hours, and then the protein synthesis was sustained by increased IGF-1 concentrations from 6-24 hours post-prandial resulting in treatment differences.

Bartol et al. (2008) demonstrated that neonatal piglets provided sows milk during the first 3 days of life had better reproductive performance later in life because of high levels of milk-borne relaxin concentrations. It was identified that there are relaxin receptors present at birth in uterine and cervical tissues, and the binding of these receptors by factors in colostrum induces estrogen receptor differentiation and proliferation through intermediates found in the stroma, called relaxomedans. After day 3, estrogen-mediated events are the basis for uterine and cervical development, and the excessive proliferation of estrogen-receptors induced by relaxin ensures that critical estrogen events are recognized and optimized and proper reproductive tissue changes are induced. The highest relaxin concentrations are found in a sow’s milk 24-48 hr after birth, correlating with production of colostrum. Detectable relaxin concentrations of 200 pg/mL are found in piglet blood plasma whereas relaxin concentrations are undetectable in piglets fed milk replacer. In addition, piglets that received relaxin versus piglets deprived of relaxin resulted in significant reproductive outcomes.

Work from Faber et al. (2005) in calves demonstrated that the amount of colostrum provided to calves at birth significantly influence pre-pubertal growth rate and showed a trend for milk yield through the second lactation. Further, Jones et al. (2004) examined the differences between maternal colostrum and serum-derived colostrum replacement. In that study, two sets of calves were fed either maternal colostrum or serum-derived colostrum replacement with nutritional components balanced. Serum-derived colostrum replacer was developed to provide essential immunoglobulins to a neonatal calf, however the colostrum replacer does not generally contain the other bioactive factors that colostrum contains. These two groups were then further separated into calves fed milk-replacer with or without animal plasma, yielding four different groups. The results demonstrated that calves fed maternal colostrum had significantly higher feed efficiency compared to calves fed serum-derived colostrum replacement. The IgG status of the calves on both treatments were nearly identical suggesting that other factors in colostrum other than IgG’s were important in contributing to the differences. Soberon and Van Amburgh (2011) continued to examine the effect of colostrum status on pre-weaning ADG and also examined the effects of varying milk replacer intake after colostrum ingestion. Calves were fed either high levels (4 liters) or low levels (2 liters) of colostrum, and then calves from these two groups were subdivided into two more groups being fed milk-replacer at limited amounts or ad-libitum. Comparing calves fed 4 liter of colostrum and ab libitum intake of milk replacer versus 2 liter of colostrum and ab libitum of milk replacer, calves fed 4 liters of colostrum had significantly higher average daily gains pre-weaning and post-weaning. Therefore, it can be logically concluded that if colostrum induces changes in feed efficiency, than the first feeding can possibly affect future milk production.

Finally, Steinhoff-Wagner et al. (2010) examined the effects colostrum has on the ability of neonates to regulate glucose, through both exogenous absorption and endogenous production. The results of this study demonstrated that calves fed colostrum had significantly higher plasma circulating glucose levels in comparison to formula fed calves, however the gluconeogenic ability did not differ between the two groups. This suggests that in colostrum-fed calves glucose absorption capacity are increased in comparison to milk-replacer fed calves, as mentioned above.
These results were verified by significantly higher postprandial glucose concentrations, and ensuing higher insulin concentrations, in colostrum fed versus milk replacer fed calves. During post-prandial periods, colostrum-fed calves had higher liver glycogen concentrations and g6pase activities, indicating better glucose and galactose hepatic absorption. This has implications for lactose digestion and absorption. First pass uptake of [U-13C]-glucose, or the glucose utilization in splanchnic tissue (intestine and liver), was lower in colostrum fed calves than milk replacer fed calves. This indicates that glucose was either less absorbed or more utilized in splanchnic tissue in formula-fed calves, resulting in lower percentage use in colostrum-fed calves. Additionally, [U-13C]-glucose concentration was significantly higher in calves fed colostrum over milk-replacer, similar to the xylose absorption data presented earlier. Again, this supports the idea that glucose absorption is enhanced in colostrum-fed calves versus milk-replacer fed calves. Finally, plasma glucose concentrations were significantly higher in calves fed colostrum during feed deprivation of 15 hours and plasma urea concentrations were significantly higher in formula-fed calves. This suggests that calves fed colostrum had higher glycogen concentrations and did not utilize protein catabolism. If the glucose uptake differences were to persist, it would help us understand the role of factors in colostrum other than Ig’s important for long-term productivity.

Standardization or evaluation of colostrum with a refractometer to ensure the appropriate solids or protein content is also important. Using a calibrated Brix refractometer, a minimum of 22% Brix provides good sensitivity and specificity for Ig levels for fresh and frozen colostrum above 50 mg/mL (Bielmann et al., 2010). Thus, anything above 22% is adequate for the first feeding for calves and anything below 22% should be reserved for later feedings. Finally, to determine total solids with a Brix refractometer, the Brix value needs to be converted. An equation from Moore et al. (2009) can be used to do this effectively, and the equation is: percent total solids = 0.9984 x (Brix%) + 2.077. Given the regression coefficients, a quick calculation is Brix% + 2 units. An evaluation of the use of a Brix refractometer was recently published by Quigley et al. (2012) and they suggested a cut point of 21% was appropriate for their data.

Colostrum is the first meal and accordingly is very important in establishing the nutrient supply needed to maintain the calf over the first day of life. The amount of colostrum is always focused on the idea we are delivering a specific amount of immunoglobulins (Ig’s) to the calf, and many times we underestimate the nutrient contribution of colostrum. Further, many times of year, we tend to underestimate the nutrient requirements of the calf, especially for maintenance. For example, a newborn Holstein calf at 85 lbs birth weight has a maintenance requirement of approximately 1.55 Mcals ME at 72 °F. Colostrum contains approximately 2.51 Mcals metabolizable energy (ME)/lb, and a standard feeding rate of 2 quarts of colostrum from a bottle contains about 1.5 Mcals ME. Thus, at thermoneutral conditions, the calf is fed just at or slightly below maintenance requirements at its first feeding. For comparison, if the ambient temperature is 32 °F the ME requirement for maintenance is 2.4 Mcals, which can only be met if the calf is fed approximately 1 lb of DM or about 3.5 quarts of colostrum. This simple example illustrates one of the recurring issues with diagnosing growth and health problems with calves and that is the use of volume measurements to describe intake instead of discussing energy and nutrient values. Two quarts of colostrum sounds good because that is what the bottle might hold, but it has little to do with the nutrient requirements of the calf.

Managing the calf for greater intake over the first 24 hours of life is important if we want to ensure positive energy balance and provide adequate Ig’s and other
components from colostrum for proper development. For the first day, at least 3 Mcals ME (approximately 4 quarts of colostrum) would be necessary to meet the maintenance requirements and also provide some nutrients for growth. On many dairies this is done via an esophageal feeder and the amount dictated by the desire to get adequate passive transfer. Those dairies not tube feeding should be encouraging up to 4 quarts by 10 to 12 hours and might be undersupplying Ig’s to the calf. Thus, the first step in supplying a “model” diet to a calf is to ensure colostrum is fed not only to meet the Ig needs of the calf, but also to ensure that the nutrient requirements are met for the first day of life.

**Nutrient status and long-term productivity**

There are several studies in various animal species that demonstrate early life nutrient status has long-term developmental effects. Aside from the improvement in potential immune competency, there appear to be other factors that are impacted by early life nutrient status.

There are several published studies and studies in progress that have both directly and indirectly allowed us to evaluate milk yield from cattle that were allowed more nutrients up to eight weeks of age. The earliest of these studies investigated either the effect of suckling versus controlled intakes or ad-libitum feeding of calves from birth to 42 or 56 days of life (Foldager and Krohn, 1994; Bar-Peled et al, 1997; Foldager et al, 1997). In each of these studies, increased nutrient intake prior to 56 days of life resulted in increased milk yield during the first lactation that ranged from 1,000 to 3,000 additional pounds compared to more restricted fed calves during the same period (Table 1). Although they are suckling studies, milk is most likely not the factor of interest, but nutrient intake in general and this is demonstrated in the more recent data.

In the study conducted at Miner Institute, Ballard et al. (2005), reported that at 200 days in milk, the calves fed milk replacer at approximately twice normal feeding rates produced 1,543 pounds milk more than the calves that received one pound of milk replacer powder per day. Calving age in that study was not affected by treatment. Overall, averaging the studies, there is a 1,500 pound response to increasing nutrient intake prior to weaning for first lactation milk yield. The significant observation is that the effect of intake level needs to be accomplished through liquid feed intake.

The responses in the studies of Shamay et al. (2005) and Moallem et al. (2010) are significant, specifically because they suggest that milk replacer quality is important to achieve the milk response, as is protein status of the animal post weaning. In that study, the calves were fed a 23% CP, 12% fat milk replacer containing some soy protein or whole milk. Further, post-weaning the calves were fed similarly until 150 days of gain, and the diets were protein deficient (~13.5% CP). Starting at 150 days calves from both pre-weaning treatments were supplemented with 2% fish meal from 150 to 300 days of life. The calves allowed to consume the whole milk (ad libitum for 60 minutes) and supplemented with the additional protein produced approximately 1,700 pounds more milk in the first lactation indicating that the early life response could be muted by inadequate protein intake post-weaning.

Finally the data of Drackley et al. (2007) again demonstrate a positive response of early life nutrition on first lactation milk yield. In this study, calves were fed either a conventional milk replacer (22:20; i.e. 22% protein, 20% fat) at 1.25% of the body weight (BW) or a 28:20
milk replacer fed at 2% of the BW for week one of treatment and then 2.5% of the BW from week 2 to 5 and then systematically weaned by dropping the milk replacer intake to 1.25% of the BW for 6 days and then no milk replacer. All calves were weaned by 7 weeks of age and after weaning all calves were managed as a single group and bred according to observed heats. The heifers calved between 24 and 26 months of age with no significant difference among treatments. Calving BW were also not different and averaged 1,278 lb. Milk yield on average was 1,841 pounds greater for calves fed the higher level of milk replacer prior to weaning.

The Cornell University Dairy Herd started feeding for greater pre-weaning BW gains many years ago and we have over 1,200 weaning weights and 3+ lactations with which to make evaluations outside of our ongoing study. What makes our approach to this unique is the application of a Test Day Model (TDM) (Everett and Schmitz, 1994; Van Amburgh et al., 1997) for the analyses of the data. This approach allows us to statistically control for factors not associated with the variables of interest and is the same approach that has been used to conduct sire summaries and daughter evaluations and develop heritabilities for genetic traits. Thus, the outcome is mathematically more robust and allows us to look within a herd over time with less bias and to look at herd responses independent of formal treatments. The resulting residuals are standardized which makes them additive over the life of the animal and they can be calculated for individual test days or over the lactation. The power of this type of analyses is much more significant compared to comparing daily milk or even ME305 milk and helps us partition out variance not associated with the variables of interest.

Table 1. Milk production differences among treatments where calves were allowed to consume approximately 50% more nutrients than the standard feeding rate prior to weaning from liquid feed.

<table>
<thead>
<tr>
<th>Study</th>
<th>Milk yield, lb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foldager and Krohn, 1991</td>
<td>3,092</td>
</tr>
<tr>
<td>Bar-Peled et al., 1998</td>
<td>998</td>
</tr>
<tr>
<td>Foldager et al., 1997</td>
<td>1,143</td>
</tr>
<tr>
<td>Ballard et al., 2005 (@ 200 DIM)</td>
<td>1,543</td>
</tr>
<tr>
<td>Shamay et al., 2005 (post-weaning protein)</td>
<td>2,162</td>
</tr>
<tr>
<td>Rincker et al., 2006 (proj. 305@ 150 DIM)</td>
<td>1,100</td>
</tr>
<tr>
<td>Drackley et al., 2007</td>
<td>1,841</td>
</tr>
<tr>
<td>Raith-Knight et al., 2009</td>
<td>1,582</td>
</tr>
<tr>
<td>Terre et al., 2009</td>
<td>1,375</td>
</tr>
<tr>
<td>Morrison et al., 2009 (no diff. calf growth)</td>
<td>0</td>
</tr>
<tr>
<td>Moallem et al., 2010</td>
<td>1,600</td>
</tr>
<tr>
<td>Soberon et al., 2011</td>
<td>1,217</td>
</tr>
</tbody>
</table>
We analyzed the lactation data of the 1,244 heifers with completed lactations using the TDM approach and statistically analyzed several factors related to early life performance and the TDM milk yield residuals (Soberon et al., 2012). The factors analyzed were birth weight, weaning weight, height at weaning, BW at 4 weeks of age and several other related and farm measurable factors. From a management perspective the most interesting observation was the relationship among two factors, growth rate prior to weaning and intake over maintenance and first lactation milk yield. In these analyses, the strongest relationship associated with first lactation milk production was growth rate prior to weaning and the findings are consistent with the data presented in Table 1. In our data set, for every 1 pound of average daily gain (ADG) prior to weaning (or at least 42 to 56 days of age), the heifers produced approximately 937 pounds more milk (P < 0.01) (Table 2). The range in pre-weaning growth rates among the 1,244 animals were 0.52 to 2.76 pounds per day and the range was actually quite puzzling to us. Our feeding program at the research farm is straightforward: 1.5% BW dry matter from day 2 to 7 and then 2% of BW dry matter from day 8 to 42 of a 28:15 or 28:20 milk replacer mixed at 15% solids. Free choice water is offered year around and starter is offered from day 8 onward. At that feeding rate, we are offering twice the industry standard amount and had assumed it was enough for overcoming the maintenance requirement and provide adequate nutrients for growth, even in the winter. However, when we analyzed the TDM residuals by temperature at birth, a very significant observation was made (Figure 1).

These data suggest that although we are meeting the maintenance requirements of the calves from a strict requirement calculation, we are not providing enough nutrients above maintenance to optimize first lactation milk production. We need to remember that the thermoneutral zone for calves is 68° to 82° F and that when the temperature drops below that
level, intake energy will be used to generate heat instead of growth. In addition, when we analyzed the data by lactation, the response increased as the animals matured (Table 2).

Table 2. Predicted differences by TDM residual milk (lb) for 1st, 2nd, and 3rd lactation as well as cumulative milk from 1st through 3rd lactation as a function of pre-weaning average daily gain and energy intake over predicted maintenance for the Cornell herd.

<table>
<thead>
<tr>
<th>Lactation</th>
<th>n</th>
<th>Predicted difference in milk per lb of pre-weaning ADG</th>
<th>P value</th>
<th>Predicted difference in milk (lb) for each additional Mcal intake energy above maintenance</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>1244</td>
<td>850</td>
<td>&lt; 0.01</td>
<td>519</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>2nd</td>
<td>826</td>
<td>888</td>
<td>&lt; 0.01</td>
<td>239</td>
<td>0.26</td>
</tr>
<tr>
<td>3rd</td>
<td>450</td>
<td>48</td>
<td>0.91</td>
<td>775</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>1st - 3rd</td>
<td>450</td>
<td>2,280</td>
<td>0.01</td>
<td>1,991</td>
<td>&lt; 0.01</td>
</tr>
</tbody>
</table>

These data demonstrate there are programming or developmental events being affected in early life that have a lifetime impact on productivity. When we evaluated the 450 animals that had completed a third lactation, we found a lifetime milk effect of pre-weaning average daily gain of over 6,000 lb of milk depending on pre-weaning growth rates. Further, 22% of the variation in first lactation milk production could be explained by growth rate prior to weaning. This suggests that colostrum status and nutrient intake and or pre-weaning growth rate have a greater effect on lifetime milk yield and account for more variation and progress in milk yield associated with the management of the calf than genetic selection. Generally, milk yield will increase 150 to 300 lbs per lactation due to selection whereas the effect of management is three to five times that of genetic selection.

In the Cornell herd, the effect of diarrhea or antibiotic treatment on ADG was not significant and ADG differed by approximately 30 g/d for calves that had either event in their records (P > 0.1). However, for calves that had both events recorded, ADG was lower by approximately 50 g/d (P < 0.01). Over the eight year period, approximately 59% of all of the calves had at least one of the recorded events.

In the data from the Cornell herd, first lactation milk yield was not significantly affected by reported cases of diarrhea. Antibiotic treatment had a significant effect on TDM residual milk and calves that were treated with antibiotics produced 1,086 lb less milk in the first lactation (P > 0.01) than calves with no record of being treated. Regardless of antibiotic treatment, the effect of ADG on first lactation milk yield was significant in all calves (P < 0.05). Calves that were treated with antibiotics produced 1,373 lb more milk per kg of pre-weaning ADG while calves that did not receive antibiotics produced 3,101 lb more milk per kg of pre-weaning ADG. The effect of increased nutrient intake from milk replacer was still apparent in the calves that were treated, but the lactation milk response was most likely attenuated due to factors associated with sickness responses and nutrient partitioning away from growth functions (Johnson, 1998; Dantzer, 2006).
An analysis of all the lactation data and the pre-weaning growth rates, when controlled for study, suggests that to achieve these milk yield responses from early life nutrition, calves must double their birth weight or grow at a rate that would allow them to double their birth weight by weaning (56 days). This further suggests that milk or milk replacer intake must be greater than traditional programs for the first 3 to 4 weeks of life in order to achieve this response.

The papers and data described in Table 1 were analyzed in a meta-analyses to further investigate the impact of nutrient intake and growth rate prior to weaning (Soberon and Van Amburgh, 2012). The analysis excluded Foldager and Krohn, (1991) due to inadequate data and Davis-Rincker et al. (2011) because they did not measure full lactations. The Morrison et al. (2009) study was included in the analysis). The software used was Used Comprehensive Meta Analyses software (www.Meta-Analysis.com) (Borenstein et al. 2005) and the data included were study, treatment size (number of calves) mean milk yield, standard error or deviation, P value and effect direction. The data of Soberon et al. (2012) was initially excluded and then included to test for weighting effects since Soberon et al. contains many hundreds of animals. Inclusion of Soberon et al. did not change the outcome and the data were included in the analyses. The analysis indicated that feeding higher levels of nutrients from milk or milk replacer prior to weaning significantly increased milk yield by 959 ± 258 lb, P < 0.001, with a confidence range of 452 to 1,463 lb of milk. Further, if ADG was included as a continuous variable among the data set, the outcome was similar to that of Soberon et al. (2012) where for every pound of pre-weaning ADG, milk yield in the mature animal increased by 1540 lb (P = 0.001).

What changes in the animal are allowing for these differences? There is no one answer to that question but investigations are looking for several factors. Although mammary development as previously measured is probably not the appropriate factor (Meyer et al., 2006a, 2006b), it is intriguing to look at very specific cells within the mammary gland. There are a couple sets of data that demonstrate increased mammary cell growth based on early life nutrient intake. Brown et al. (2005) observed a 32 to 47% increase in mammary DNA content of calves fed approximately 2 versus 1 pound of milk replacer powder per day through weaning. Just like the milk production increases discussed earlier, this mammary effect only occurred prior to weaning. In fact, this increase in mammary development was not observed once the calves were weaned, indicating the calf is more sensitive to level of nutrition prior to weaning and that the enhancement mammary development cannot be “recovered” once we wean the animal.

Meyer et al. (2006a) observed a similar effect in mammary cell proliferation in calves fed in a similar manner. The calves on their study demonstrated a 40% increase in mammary cell proliferation when allowed to consume at least twice as much milk replacer as the control group before weaning (Meyer et al., 2006a). Sejrsen et al (2000) observed no negative effect on mammary development in calves allowed to consume close to ad libitum intakes. A more specific attempt to look at stem cell proliferation did not find increased stem cells in calves fed higher levels of nutrient intake (Daniels et al., 2008) and it was hypothesized that the stem cell proliferation might lead to greater secretory cells once the animal becomes pregnant.
Economics

An in depth economic analyses of a program designed to double the birth weight and decrease age at first calving by almost 3 months was conducted by Dr. Mike Overton with input from Dr. Bob Corbett (Overton, 2010). In his analyses he utilized both research and herd data to characterize the costs and potential income associated with feeding and managing calves in a manner to promote a milk yield response. In his analysis, the first lactation profit was $190 per heifer without accounting for the increase in inventory and what that means to changes in either voluntary culling or heifer sales. The change in profitability was due to the average 1,700 lb milk response observed from the studies described in Table 1 and was adjusted for net present value of the investment today relative to the income two years from now.

We conducted our own analysis of the response using calf and heifer performance data from a herd used in a heifer cost benchmarking study from New York (Table 3). There are many terms for the difference in management of the calves – in this analyses we will call it intensified but it really represents more biologically normal growth. Actual health data, feed costs and total costs of rearing were included in the estimation. Age at first calving was a function of getting heifers pregnant at 55% of the mature body weight and then calving at a minimum of 82% in both systems. In our analyses, AFC was reduced by 2.3 months, but the costs associated with achieving the same body weight post calving were nearly identical due to the higher costs of feeds and the amount of feed consumed to achieve the earlier AFC.

While the cost per heifer completing the system did not change, there are several other areas where there is economic value associated with the decreased calving age and the decrease in non-performance expense. If at the start the same number of heifer calves each month, there will be on average 2 more animals completing the system each year. There is also a decrease in the total number of animals in the replacement program, dropping 8%. This could allow the dairy to grow larger with the same replacement system, or allow the dairy to investment in a replacement program that was 8% smaller than before. The third area to impact profitability is the increased performance of the heifer in the dairy herd.

Using a model that treats the replacement program as a separate enterprise within the dairy, we looked at the combined changes for this herd, decreasing the calving age to 22.2 months, decreasing the non-performance rate to 7.5%, and fully transferring the increased value of production in the lactating herd. The non-completion rate was reduced due to a reduction in death loss with greater nutrient intake prior to weaning with no changes post-weaning, indicating there will be more heifers available to enter lactation. The base replacement enterprise was generating a return of 0.87% on assets invested in the replacement program. With all the changes, the return increased to 7.2% (Table 4).

The profitability increase is due to the potential decrease in inventory due to calving approximately 3 months earlier and the milk yield increase due to improved nutrition and management from birth. The management decisions associated with the inventory change due to AFC are difficult to generalize among all herds and it is really a one-time adjustment to the cost of production. However, given the potential change in milk yield over the life-time of the animal, the change in calf management in a program that maintains the targets throughout the growing phase is worth approximately $211, assuming a discount of 7% per year over the three year period,
a $15 milk price, an income over feed costs of $10.50. This value is similar to the profit calculation of Overton (2010) and an outcome of the average milk response we are using to make the estimation along with the individual assumptions about costs of management.

**Table 3.** Cost assessment of conventional versus intensified calf and heifer programs

<table>
<thead>
<tr>
<th></th>
<th>Conventional</th>
<th>Intensified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-weaning cost per pound gain, $</td>
<td>2.73</td>
<td>2.91</td>
</tr>
<tr>
<td>Total pre-weaning gain, lb</td>
<td>64</td>
<td>102</td>
</tr>
<tr>
<td>Age at pregnancy, mo.</td>
<td>15.4</td>
<td>12.2</td>
</tr>
<tr>
<td>Age at first calving, mo</td>
<td>24.5</td>
<td>22.2</td>
</tr>
<tr>
<td>Overall average daily gain from birth, lb</td>
<td>1.70</td>
<td>1.89</td>
</tr>
<tr>
<td>Body weight at calving, lb</td>
<td>1,350</td>
<td>1,350</td>
</tr>
<tr>
<td>Percent non-completion rate, % entering replacement program</td>
<td>10.2</td>
<td>7.5</td>
</tr>
<tr>
<td>Total cost per heifer, $</td>
<td>1,738</td>
<td>1,740</td>
</tr>
<tr>
<td>Total investment per heifer, $</td>
<td>1,887</td>
<td>1,890</td>
</tr>
</tbody>
</table>

**Table 4.** Replacement enterprise impact for selected management changes for a 250 cow herd.

These values represent the differences in expenses associated with the heifer rearing enterprise associated with the calf raising program.

<table>
<thead>
<tr>
<th></th>
<th>Base</th>
<th>Lower Calving Age</th>
<th>Lower Non-Completion Rate</th>
<th>Combined Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heifers to cows ratio, %</td>
<td>76</td>
<td>68</td>
<td>74</td>
<td>69</td>
</tr>
<tr>
<td>Total rearing costs, $</td>
<td>1,736</td>
<td>1,739</td>
<td>1,701</td>
<td>1,724</td>
</tr>
<tr>
<td>Income per animal, $</td>
<td>1,900</td>
<td>1,900</td>
<td>1,900</td>
<td>2,104</td>
</tr>
<tr>
<td>Completing system total investment, $</td>
<td>223,142</td>
<td>202,348</td>
<td>217,508</td>
<td>211,692</td>
</tr>
<tr>
<td>% Return on Capital</td>
<td>0.87%</td>
<td>0.53%</td>
<td>1.75%</td>
<td>7.27%</td>
</tr>
</tbody>
</table>

**Summary**

Early life events have long-term effects on the performance of the calf. Our management approaches and systems need to recognize these effects and capitalize on them. We have much to learn about the consistency of the response and the mechanisms that are being affected. Given the amount of variation accounted for in first and subsequent lactation milk yield, there are opportunities to enhance the response once we know and understand those factors. The bottom line is there is a positive economic outcome to improving the management of our calf and heifer programs starting at birth.
References


Management Opportunities for Improving Profitability of SE Dairies: Where are the Real Dollars?

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Management opportunities for improving profitability of SE dairies: Where are the real dollars?
Bruno do Amaral, Ph.D.
Dairy Nutritionist Consultant
Calf and Heifer Specialist
Purina Animal Nutrition LLC

Agenda
• Background
• Opportunities for SE
  – TEAMWORK
  – Management – heat abatement
  – Nutrition – Feeding
  – Grouping / Rations
  – Calf and Heifer program

Background

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Together
Everyone
Achieves
More

TEAMWORK
coming together is a beginning
keeping together is progress
working together is success
- Henry Ford

Teamwork
Owner, nutritionist, veterinarian,
herd manager, feeder, pusher,
milker…everyone at the farm
is equally important to the
success and profitability of
the business

Teamwork
• Job description – training – expectations
• Accountability
• Set goals – know your KPIs
• Team meetings
Agenda

- Background
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  - Grouping / Rations
  - Calf and Heifer program

Heat Stress Abatement

Heat Stress Dry Cows

- Florida studies
  - Experiment 1
  - Experiment 2
  - Experiment 3
Milking Cows

- After calving
  - All cows were housed in a free stall barn with cooling (fans and misters)

Calf Body Weight (lbs)

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Heat Stress</th>
<th>Cooling</th>
<th>Difference (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>68.3</td>
<td>97.0</td>
<td>28.7</td>
</tr>
<tr>
<td>2</td>
<td>87.0</td>
<td>98.0</td>
<td>11.0</td>
</tr>
<tr>
<td>3</td>
<td>91.7</td>
<td>102.4</td>
<td>10.7</td>
</tr>
</tbody>
</table>

Fans and Sprinklers

- On: 71°F
-Sprinklers: On for 2 min, Every 5 min
Heat Stress Decreases Calf Birth Weight

Cooling Cows Prepartum Improves Milk Production in the Subsequent Lactation

Experiment 2 - FCM

Experiment 3 - Milk Production
Heat Stress Abatement Increased Mammary Epithelial Cell Proliferation In the Dry Period

Experiment 3 – Mammary Gland Development

Effects of Heat Stress in Utero on Calf Performance
Maternal Heat Stress Decreases Serum Total IgG of Calves

Treatment effect: $P = 0.03$

TRT: $P = 0.03$

Tao et al., 2012a

Maternal Heat Stress Impairs Lymphocyte Proliferation of Offspring

TRT: $P = 0.05$

Tao et al., 2012a

Maternal Heat Stress Decreases Offspring’s Milk Production

Trt: $P = 0.11$

Cooling: 68 lbs
Heat stress: 58 lbs

 Effects of Heat Stress on Lactation

Trt: $P = 0.11$

Cooling: 68 lbs
Heat stress: 58 lbs

Trt: $P = 0.11$

Cooling: 68 lbs
Heat stress: 58 lbs

Trt: $P = 0.11$

Cooling: 68 lbs
Heat stress: 58 lbs

Trt: $P = 0.11$

Cooling: 68 lbs
Heat stress: 58 lbs

Trt: $P = 0.11$

Cooling: 68 lbs
Heat stress: 58 lbs
Bucket Facing of Defacer

Agenda

• Background
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Nutrition - Feeding

• What are your goals?
  -- Milk production
  -- Health
  -- Reproduction
  -- Butterfat
  -- Cost
  -- Profitability

Goals

Specific
Measurable
Attainable
Relevant
Time-bound
Nutrition - Feeding

- What are your goals?
  - Milk production
  - Health
  - Reproduction
  - Butterfat

- Do you know your KPIs?
- Do you use reliable data to make intelligent decisions

Cost or Profitability?
Use reliable data to make decisions and not feelings.
Calibrate Values
Why use Ruminal Digestibility Data?

- Increasing feed efficiency
- Diet cost savings (substituting high cost ingredients with lower cost ingredients)
- Forage management
  - Hybrid and specie selection for higher digestibility
  - Harvest management
  - Storage management
- Increasing dietary energy safety (higher corn silage $$\$$)
- Milk composition diagnosis
- Ingredient inventory management and availability
  - Tight inventory or availability
- Increasing dry matter intake (DMI) and production
- Increasing dietary forage levels

Calibrate - Okeechobee, FL

6.8 lbs of milk

Calibrate – Mayo, FL

12 lb DM corn silage

Calibrate – Mayo, FL

27 lb DM corn silage
**Feed Efficiency**

- Lbs of milk per lbs of DM consumed
- Optimum range of 1.4 to 1.8
- Forage quality, days in milk, age, growth, changes in BCS, body weight, feed additives, and environmental factors will impact feed efficiency.

---

**Profitability Opportunity Example**

<table>
<thead>
<tr>
<th>Lactation #</th>
<th>Rally base feeding rate</th>
<th>Cost/cow</th>
</tr>
</thead>
<tbody>
<tr>
<td>2nd</td>
<td>1.1</td>
<td>$0.42</td>
</tr>
<tr>
<td>3rd</td>
<td>1.1</td>
<td>$0.42</td>
</tr>
</tbody>
</table>

---

**Rally – Okeechobee, FL**

- Milk production from 1 - 40 DIM with or without Rally
- 3:1 ROI
- 5:1 ROI
Groups / Rations

- Fresh heifers
- Fresh cows
- High group
- Middle – low pregnant
- Far off
- Close up

Feed Efficiency - $$$$  

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Herd A</th>
<th>Herd B</th>
<th>Herd C</th>
<th>Herd D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk, lb/cow</td>
<td>87</td>
<td>82</td>
<td>76</td>
<td>72</td>
</tr>
<tr>
<td>DMI, lb/cow</td>
<td>51.7</td>
<td>51</td>
<td>51</td>
<td>50.5</td>
</tr>
<tr>
<td>Feed Efficiency</td>
<td>1.08</td>
<td>1.61</td>
<td>1.49</td>
<td>1.43</td>
</tr>
<tr>
<td>Milk Income $/25/lwt</td>
<td>18.27</td>
<td>17.22</td>
<td>15.98</td>
<td>15.12</td>
</tr>
<tr>
<td>Feed Cost @ 0.15/lb of DM</td>
<td>7.70</td>
<td>7.60</td>
<td>7.05</td>
<td>7.58</td>
</tr>
<tr>
<td>Income over feed cost</td>
<td>10.52</td>
<td>9.57</td>
<td>8.31</td>
<td>7.55</td>
</tr>
<tr>
<td>Cost (feed) to produce 100 lbs of milk</td>
<td>8.91</td>
<td>9.35</td>
<td>10.07</td>
<td>10.52</td>
</tr>
</tbody>
</table>

Income Opportunities on Feed Efficiency Improvements

- Change in income over feed cost: $3.57, $1.41, $0.41
- Opportunity/day: $53.70, $51.40, $54.15
- Opportunity/month: $107,100, $42,150, $12,490

Agenda

- Background
- Opportunities for SE
  - TEAMWORK
  - Management – heat abatement
  - Nutrition - Feeding
  - Grouping / Rations
  - Calf and Heifer program

Grouping Fresh Cows

- Milk production from 1 - 40 DIM
- Aug 04
- Sep 04
- Oct 04
- Nov 04
- Dec 04
- Jan 05
- Feb 05

Milk Production (lb/cow/day)

- Lactation 1
- Lactation 2
- Lactation 3
- Lactation 4
Agenda

• Background
• Opportunities for SE
  – TEAMWORK
  – Management – heat abatement
  – Nutrition -Feeding
  – Grouping / Rations
  – Calf and Heifer program

Calf and Heifer Program

• What are your goals?
  – Cheap, cheap, cheap
  – Cost/day
  – Cost/lb of gain
• Do your 1st lactation animals peak at 85% of what your mature cows are peaking?
• What is the age at first calving?
• What is BW at first calving?

Calf and Heifer Program

• Do you know your numbers?
  – What is the ADG up to weaning?
  – What is mortality?
  – What is morbidity?
  – What is your cost/lb of gain

What do beef calves get?

• Beef calves drink 4 to 8 times per day
• About 20 lb. or 2.4 gallons (~10 quarts) per day
• At 12.5% solids = 2.5 lb of dry matter per day
• 27% protein, 30% fat (dry matter basis)

What does a typical dairy calf get?

• Milk fed twice/day
• ¾ to 1 gallon per day
• Usually delivering 0.75 to 1 lb of dry matter per day
• 20% protein, 20% fat (dry matter basis)
What is the Result?

- **Beef: All Calves**
  - 2.1% born dead
  - 1.1% dead within 24 hours
  - 2.3% mortality from 24 hours to weaning
- **Dairy: Heifer Calves**
  - 6.5% stillborn & dead at 48 hours
  - 7.8% mortality from 48 hours to weaning
- **5.5% total loss; birth to weaning**
- **14.3% total loss; birth to weaning**

Efficiency of feed conversion with traditional calf feeding practices compared to those fed a higher plane of nutrition (Birth to 6 weeks)

Feeding 3X Daily

- Coincidence or trend? Trying to do what is best for the calf!

Adapted from Davis and Drackley, 1998
Pasteurized Milk Balancer
SE Trial
Bruno Amaral, Ph.D.
Calf and Heifer Specialist
Dairy Nutritionist Consultant
Purina Animal Nutrition LLC

Body Weight Gain

<table>
<thead>
<tr>
<th>Gain (lbs)</th>
<th>49 days</th>
<th>63 days</th>
<th>70 days</th>
<th>81.5 days</th>
<th>102 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>63.1</td>
<td>76.9</td>
<td>81.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balancer</td>
<td>86.6</td>
<td>102.5</td>
<td>112.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Cost / lbof gain

<table>
<thead>
<tr>
<th></th>
<th>49 days</th>
<th>63 days</th>
<th>69 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balancer</td>
<td>$2.26</td>
<td>$2.06</td>
<td>$1.97</td>
</tr>
<tr>
<td>Control</td>
<td>$2.29</td>
<td>$2.19</td>
<td>$2.05</td>
</tr>
</tbody>
</table>

Treatment and Mortality Costs

<table>
<thead>
<tr>
<th></th>
<th>Treatment$/calf</th>
<th>Mortality $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balancer</td>
<td>$7.81</td>
<td>$6.75</td>
</tr>
<tr>
<td>Control</td>
<td>$11.51</td>
<td>$12.84</td>
</tr>
</tbody>
</table>
### Summary

- **Calves fed Pasteurized Milk Protein Blend (Balancer):**
  - Gained 24 lbs (16.1%) more weight
  - Were 1.3 inches (3.8%) taller
  - Were 2.2 inches (7.3%) longer
  - Had 33 L (17.2%) more body volume
  - $0.25 (17.2%) cheaper/lb of gain
Thank you

Bruno do Amaral, Ph.D.
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(904) 671-3380
MANAGEMENT OPPORTUNITIES FOR IMPROVING PROFITABILITY OF SE DAIRIES: WHERE ARE THE REAL DOLLARS?

Bruno do Amaral, Ph.D.
Dairy Nutritionist Consultant
Calf and Heifer Specialist
Purina Animal Nutrition LLC

INTRODUCTION

If somebody told you that you could increase milk production in your herd without changing the ingredients and cost of the ration, would you believe it? If your answer is NO, I hope you will change your mind after this discussion. If your answer is YES, I hope you can finish up writing this chapter… (just kidding). My objective on writing this paper is to bring up areas of opportunities for improving the profitability of your farm (teamwork, management, nutrition, feeding, grouping, rations, and calf and heifer program).

I always heard that “behind every great/successful man there stands a woman”. Indeed, this is very well true. In my career, I have seen that behind every successful dairy farm, stand a great team of people. They are the ones pulling together for the success of the dairy. Focus on teamwork on your operation will pay off big time. There is no “I” on the TEAM and everyone at the farm is equally important to the success and profitability of the business. Build a good team and you will have a successful and profitable story to tell.

Among the opportunities for the dairies to improve profitability, management practices such as cooling cows is a high priority in the SE. Heat stress during lactation accounts for 10 to 25% of milk production loss on average (Collier et al., 2006). In states that are not as prepared for cooling cows as the SE, when heat waves come there is anywhere from 4 to 30 lb-drop in milk production.

On the other hand, how can we quantify the effects of heat stress on dry cows? Is there really an effect of heat stress on dry cows? During the dry period, the cells in the udder are recovering from the previous lactation and preparing for the next. This is the time to replace the old milk secretory cells and make them grow for supporting milk production for the next lactation. Heat stress during this important time of cell turnover can dramatically impact transition into the subsequent lactation.

I will describe the series of experiments done at the University of Florida evaluating the effects of heat stress on dry cows.

EXPERIMENT 1

Researchers at the University of Florida (do Amaral et al., 2009) evaluated the effects of heat stress on dry cows. Cows were dried off 45 days before the due date and assigned to two...
treatments: heat stress (HT) and cooling (CL). Cows were kept in a free stall barn (Figure 1). Cows under cooling had fans and sprinklers whereas the heat-stressed group did not. Both treatments received the same dry cow ration from dry off until they calved. After calving, the animals were moved to a sand-bedded free stall with fans (J&D Manufacturing, Eau Claire, WI) and sprinklers (Rainbird Manufacturing, Glendale, CA) that turned on automatically whenever the ambient temperature exceeded 70° F. Cows were heat stressed only during the dry period. Milking cow ration was similar for both groups.

Figure 1- Free stall barn divided into four quadrants for the heat stress and cooling treatments.

Figure 2- Free stall barn bedded with sand and equipped with fans and sprinklers for the milking cows.
RESULTS EXPERIMENT 1

Cows exposed to heat stress tended to have a dry period 7 d shorter than those that were cooled (38 vs. 45 d, respectively). Calf BW was 28.7 lb lighter for calves born from cows under heat stress compared with those born from cooled cows (68.3 vs. 97 lb, respectively). Rectal temperature for heat-stressed cows was higher than cooled cows (102.5 vs. 101.3 °F, respectively).

Milk production up to 30 weeks of lactation was higher for cows cooled during the dry period compared to those heat-stressed (Figure 3). The average increase in 3.5% FCM in cooled cows was 18.7 lb of milk/cow/day (Table 1) compared to cows exposed to heat stress.

**Remember that in this experiment the cows were heat-stressed only during the dry period.**
The magnitude of response in milk production is related to heat stress load and intensity.

**Figure 3. Effects of cooling or heat stress during the dry period on the production of milk in the subsequent lactation (Adapted from do Amaral et al., 2009).**

![Graph showing milk production](image)

**Table 1- Milk yield, 3.5% FCM yield, 3.5% FPCM yield, ECM yield, and milk components of cows exposed to heat stress or cooling during the dry period.**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Heat Stress</th>
<th>Cooling</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk yield, lb/day</td>
<td>57.7</td>
<td>74.3</td>
<td>0.04</td>
</tr>
<tr>
<td>3.5% FCM, 1 lb/day</td>
<td>57.5</td>
<td>78.0</td>
<td>0.01</td>
</tr>
<tr>
<td>3.5% FPCM, 2 lb/day</td>
<td>57.3</td>
<td>76.0</td>
<td>0.02</td>
</tr>
<tr>
<td>ECM, 3 lb/day</td>
<td>58.0</td>
<td>76.9</td>
<td>0.02</td>
</tr>
<tr>
<td>Fat, %</td>
<td>3.5</td>
<td>3.9</td>
<td>0.07</td>
</tr>
<tr>
<td>Protein, %</td>
<td>3.2</td>
<td>3.0</td>
<td>0.62</td>
</tr>
<tr>
<td>Fat yield, lb/day</td>
<td>1.98</td>
<td>2.87</td>
<td>0.01</td>
</tr>
<tr>
<td>Protein yield, lb/day</td>
<td>1.76</td>
<td>2.204</td>
<td>0.09</td>
</tr>
</tbody>
</table>

1. 3.5% FCM = (0.4324 × milk yield) + (16.216 × milk fat yield).
2. 3.5% fat- and protein-corrected milk (FPCM) = (12.82 × kg of fat) + (7.13 × kg of protein) + (0.323 × kg of milk).
3. ECM = (0.327 × kg of milk) + (12.95 × kg of fat) + (7.20 × kg of protein) (Tyrrell and Reid, 1965).
This experiment confirms that exposure of cows to cooling during the dry period increases milk production relative to animals exposed to heat stress, as observed in other studies as well (Wolfenson et al., 1988; Avendaño-Reyes et al., 2006; Urdaz et al., 2006). Milk fat concentration and yield were greater for cooled cows compared with heat-stressed cows. Similarly, Avendaño-Reyes et al. (2006) reported an increase in milk fat yield in the subsequent lactation with cows that were cooled prepartum compared with cows under heat stress. However, it must be emphasized that there were differences in the duration and intensity of cooling among previous studies and the current experiment. For example, Collier et al. (1982) provided only shade as the heat stress abatement treatment, whereas in this study heat-stressed cows were shaded. Urdaz et al. (2006) only cooled cows during the final 3 wk of the dry period, whereas this study cooled cows for the entire dry period. These experimental differences might explain the apparently large milk yield response in the current study relative to earlier reports. Collier et al. (1982) attributed the effects of heat stress during late gestation to reduced placental and maternal hormone production, which in turn reduced mammary gland growth and postpartum function. These results do not exclude the possibility that a reduction in placental function might also contribute to the lesser milk yield of heat-stressed cows. Indeed, given the aforementioned spectrum of responses to dry period heat stress abatement on subsequent yield, it is likely that multiple factors are responsible for the loss of production.

**EXPERIMENT 2**

This second experiment (do Amaral et al., 2011) had a similar design as experiment 1 (do Amaral et al., 2009) and evaluated the effect of heat stress on immune function in addition to milk production and components.

Rectal temperature was increased in heat-stressed cows compared to those cooled (102.4 vs. 101.8°C, respectively). In addition, heat-stressed cows had greater respiration rates (78 vs. 56 breaths/min, respectively), shorter dry period (39 vs. 46 d, respectively), and lighter calves (87 vs. 98 lb, respectively). The average increase in 3.5% FCM in the subsequent lactation was 10.3 lb/cow/d in cows cooled during the dry period compared to the heat stressed cows (Table 2 and Figure 1).

**Table 2- Milk yield, 3.5% FCM yield, 3.5% FPCM yield, ECM yield, and milk components of cows exposed to heat stress or cooling during the dry period.**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Heat Stress</th>
<th>Cooling</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk yield, lb/day</td>
<td>71.0</td>
<td>76.0</td>
<td>0.09</td>
</tr>
<tr>
<td>3.5% FCM,1 lb/day</td>
<td>67.9</td>
<td>78.2</td>
<td>0.07</td>
</tr>
<tr>
<td>3.5% FPCM,2 lb/day</td>
<td>67.0</td>
<td>75.8</td>
<td>0.11</td>
</tr>
<tr>
<td>ECM,3 lb/day</td>
<td>67.7</td>
<td>76.5</td>
<td>0.11</td>
</tr>
<tr>
<td>Fat, %</td>
<td>3.3</td>
<td>3.8</td>
<td>0.01</td>
</tr>
<tr>
<td>Protein, %</td>
<td>2.9</td>
<td>2.8</td>
<td>0.41</td>
</tr>
<tr>
<td>Fat yield, lb/day</td>
<td>2.20</td>
<td>2.87</td>
<td>0.02</td>
</tr>
<tr>
<td>Protein yield, lb/day</td>
<td>1.98</td>
<td>2.204</td>
<td>0.67</td>
</tr>
</tbody>
</table>

13.5% FCM = (0.4324 × milk yield) + (16.216 × milk fat yield).
23.5% fat- and protein-corrected milk (FPCM) = (12.82 × kg of fat) + (7.13 × kg of protein) + (0.323 × kg of milk).
3ECM = (0.327 × kg of milk) + (12.95 × kg of fat) + (7.20 × kg of protein) (Tyrrell and Reid, 1965).
Figure 1. Effects of cooling or heat stress during the dry period on the production of milk in the subsequent lactation (Adapted from do Amaral et al., 2011).

EXPERIMENT 3

The third year experiment was similar to the previous two in design and evaluated the effect of heat stress on mammary gland cell proliferation in addition to milk production and components. The authors reported that cows exposed to heat stress during the dry period produced on average 11 lb less milk than those cooled (Figure 2).

In order to understand the reason for the low milk production in heat-stressed cows, this study also evaluated how the mammary gland cells of cooled or heat-stressed cows proliferate. Heat stress decreased mammary epithelial cell proliferation which may be a contributing factor for the low milk yield.
In addition to cooling, cows need to be comfortable to produce milk. Bedding is a key factor on cow comfortable and needs to be a priority. It is important that we maximize the amount of hours that cows lie down. The frequency of bedding stalls, the depth of the stalls and the stocking density of your barn will impact milk production.

Water quality and availability is also important for dairy cows. We need to provide clean quality water during all times. During heat stress water intake will increase. The attention to details will make a difference.

The use of technology nowadays helps the dairyman to be more efficient and more profitable. Understanding ruminal digestibility of starch and fiber helps the nutritionists tremendously on formulating rations that will maximize forage intake and improve profitability at the farm. Calibrate® technology measures ruminal digestibility of starch and fiber on a proprietary GPN and RUNDF scale that in combination with the Calibrate® nutritional calculator, deliver the precise information for the nutritionist to improve feed efficiency, milk production and components, and profitability.

In addition to provide current information on your forage and ingredients, it allows you to create a data base to improve your forage program (hybrid and specie selection for higher digestibility, harvest management, storage management, etc).

On several herds across the country, the average ROI on Calibrate® is greater than 6:1.

Another area of opportunity for the SE dairies is the calf and heifer program. When it comes to calf nutrition, do you know your numbers?

Calf raising practices across the country can be very different and each farm has its own way of raising their calves. However, the end goal on most calf operations is universal: to raise calves economically in order to achieve optimal performance once they freshen. “While very simple in theory, this goal may not be attainable if producers and calf managers don’t have a system in place to measure the effectiveness of their calf nutrition program”. Key performance indicators or KPIs are often used to evaluate the performance of the lactating herd. KPIs can also be useful tools to assist in evaluating calf performance and how calf nutrition programs
contribute to lifetime profitability of the operation. Use KPIs to make more informed
management decisions.

In order to exemplify the importance of utilizing KPIs, I will share with you an actual
herd that I worked with recently. This operation was evaluating the cost-effectiveness of
implementing a higher plane of nutrition in its calf feeding program versus continuing with its
existing feeding program.

Two feeding programs evaluated:
1- Current feeding program: Pasteurized waste milk and an 18 percent calf starter.
2- Higher plane of nutrition feeding program: Pasteurized waste milk with a Pasteurized
Milk Balancer® supplement along with a 20 percent calf starter. (A Pasteurized Milk
Balancer® (Purina Animal Nutrition LLC) is a supplement product developed to be
added to pasteurized milk to increase the total solids fed and also to balance fat and
protein in the final solution.)

IN order to determine which program would add more to the dairy’s bottom line, we
evaluated both programs at the farm level, using 20 animals per treatment.

Both groups received the following liquid nutrition:
- At birth: 4 quarts of colostrum
- Maternity barn: 2 quarts 8-12 hours after birth

Pasteurized waste milk was then fed at the following rates:
- Day 1-14: 2 quarts twice per day
- Day 15-28: 3 quarts twice per day
- Day 29-42: 4 quarts twice per day
- Day 43-49: 8 quarts once per day

The total solids concentration in the pasteurized milk averaged 12.5 percent total solids.
For the group fed a higher plane of nutrition, 0.5 pounds of Pasteurized Milk Balancer®
supplement was added per gallon of pasteurized milk. The solution of pasteurized milk plus
Pasteurized Milk Balancer® supplement averaged 16.5 percent total solids.

During the field demonstration, starter intake was also measured on all calves from birth to
weaning (49 days). Throughout the field demonstration, calves on the higher plane of nutrition
doubled their birth weight in 49 days whereas those on the pasteurized milk only did not. The
average daily gain for calves that were fed a higher plane of nutrition was 1.77 pounds per day
compared to 1.29 pounds per day for calves fed pasteurized milk only. The cost per pound of
gain up to weaning on the group fed a higher plane of nutrition was $2.26 per pound of gain
compared to $2.29 per pound of gain for calves fed pasteurized milk only.

At first glance, it looked as if there was an advantage to feeding calves a higher plane of
nutrition of only $0.03 per pound of gain. However, there are other contributing factors that
affect profitability besides weight gains. Thus, we decided to take it a step further by evaluating
treatment and mortality costs.

For the higher plane of nutrition group, treatment and mortality costs averaged $7.81 per
calf and the pasteurized milk only group had average treatment costs of $11.51 per calf. There
was a lot of money spent on treatments in the group fed a lower level of nutrition.

If calves do not ingest enough nutrients to support growth and immune function, their
defense mechanism can become compromised and treatment and mortality cost could be
increased.
Use KPIs to make intelligent decisions. By knowing all the KPIs (including treatment and mortality cost), this producer was able to evaluate the cost per pound of gain adjusted for treatment and mortality cost which was $2.43 per pound of gain on the higher plane of nutrition group compared to $2.68 on the pasteurized milk group. From this, it was concluded that calves fed a higher level of nutrition increased farm profitability $0.25 per pound of gain. From this exercise, we found that measuring calf performance and tracking KPIs of interest can help dairy producers make more informed decisions to maximize lifetime profitability. To put it simply, by measuring all of your costs, you are able to make wiser economic decisions for your calf feeding program.

**TAKE HOME MESSAGES**

- Built a team of people on your operation. This is the key for your success.
- Heat stress abatement strategies for your dry and milking cows pay off big time.
- Focus on cow comfort (bedding, water quality, cooling).
- Identify your goals and focus on them.
- Take advantage of available technology and information to improve your profitability. There is no need to reinvent the wheel.
- Understand your KPIs, feed a higher plan of nutrition to your calves, be more profitable.
- Travel to different places, conferences, operations. Fresh air and new ideas will help you be more profitable.

**REFERENCES**


Producer’s View of Staying Ahead in the Dairy Business: 
Strategy for Brooksco, Jeffco, and Westbrook 

Calvin Moody 
Brooksco, Jeffco, and Westbrook Farms 
Quitman, GA 31643 
moodyBCD@aol.com 

Simplicity

• Purchased Feed Model. 
• Exclusively focused on milking cows and growing heifers. 
• Three farms with very similar layouts. 
• Parallel parlors, six row barns, palpation rails, and recycled sand bedding. 
• Centralized calving. 
• Heifers are contracted to Brooksco’s heifer facility.
Focal Points

- Asset Management
- Working Capital
- Strength of Relationships
Dupont Model

• Return on Assets = Asset Turn Over \times Operating Profit Margin

• ATO = Net Sales / Total Assets

• OPM = Operating Income / Net Sales

Asset Management

• Hard Assets: Proper Allocation of Capital

• Soft Assets: Building Managers of Hard Assets
Hard Assets

• Capital efficiency should be taken into consideration when allocating capital for new assets.
• High investment requires high levels of production and less room for mistakes.
• Avoid dead or slow turning assets but not at the expense of the farm’s future.
• Avoid the point of diminishing returns.

Soft Assets

• Building people is a culture that continues even when there is no immediate growth anticipated.
• No business can grow hard assets without first developing soft assets.
• Pre-notification letters are never sent out prior to the arrival of great opportunities.
Working Capital

• The higher the level of working capital the greater the security against uncertainty.

• “Fat Pitches” are seldom missed if the war chest is not depleted.

Strength of Relationships

• Relationships should be protected and valued.
• Strong relationships allow us to use our assets and time in the most efficient manner.
• We must avoid entering into relationships with companies or individuals that are self-serving or have different core values.
• End bad relationships as quickly and painlessly as possible.
Producer’s View of Staying Ahead in the Dairy Business:
Staying Ahead – Wisconsin Style

Don Niles
Dairy Dreams LLC
Casco, WI 54213
donniles@dairy-dreams.com

STAYING AHEAD-
WISCONSIN STYLE
(OR AT LEAST TRYING TO)

Don Niles DVM
Dairy Dreams LLC

Overview and History of Kewaunee County

• 2nd highest cows/sq mile east of Rockies
• More cows (42,000) than people (30,000)
• More digesters than any other county
• Tremendous dairy heritage
• Strong political support from both parties in Madison
Wisconsin Cow and Herd Trends

Kewaunee County #’s Up!
Overview and History of Dairy Dreams

Wisconsin Trend vs Kewaunee Since 1975 NASS

- Increase in Prod/cow: 84%
- Increase in Total Prod: 183%
Overview and History of Dairy Dreams

• Partnership of Don Niles and John Pagel
• Started milking cows in 2002
• Several planned expansions from 1200 to 2800
  • 2004 expanded to 1400 all on one site
  • 2006 expanded to 2100 brought calves home
  • 2008 expanded to 2500
  • 2010 built digester
  • 2012 brought all young stock home

Recent Shockwave of Environmentalist Activity
So What Does “Staying Ahead” Mean Now?
Two Controlling Factors

- The rest of the dairy industry is constantly improving
  - 3000 cows and competent is no longer a guarantee of success in Wisconsin

- More cows (and more manure) may not be a local option

Dairy Dream’s Idea of “Staying Ahead”

- We need to continue to extract more value from our current footprint
  - Not a new idea, but a heightened focus
- We need to create and fill a niche as a “Preferred Manure Producer” of Kewaunee County
## Extracting More Value

<table>
<thead>
<tr>
<th>Year</th>
<th>Milk/Cow</th>
<th>ECM/Cow</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>82.4</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>78.3</td>
<td></td>
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<tr>
<td>2009</td>
<td>83.7</td>
<td></td>
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<tr>
<td>2010</td>
<td>83.2</td>
<td>83.5</td>
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<td>2011</td>
<td>82.8</td>
<td>84.6</td>
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<tr>
<td>2012</td>
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<td>90.2</td>
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<tr>
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<td>85.4</td>
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<tr>
<td>2014</td>
<td>86.8</td>
<td>92.6</td>
</tr>
</tbody>
</table>
Extracting More Value

<table>
<thead>
<tr>
<th>Year</th>
<th>Milk/Cow</th>
<th>ECM/Cow</th>
<th>Milk/Facility</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>82.4</td>
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<td>90.2</td>
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<td>85.4</td>
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<td>86.8</td>
<td>92.6</td>
<td>238,134</td>
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</table>

Improving and Preserving Genetic Progress

- Preserving
  - Focus on DOA's, Calf mortalities, Fresh culls and deads
  - Goal from birth to fresh is 95%
  - Goal for <60 day culls and deads is 5.0%
Maternity Protocols

Calf Protocols
## Improving and Preserving Genetic Progress

<table>
<thead>
<tr>
<th>Year</th>
<th>DOA</th>
<th>&lt;60 cull</th>
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<tbody>
<tr>
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<tr>
<td>2008</td>
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<td>7.10</td>
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<tr>
<td>2010</td>
<td>5.60</td>
<td>5.80</td>
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<tr>
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<td>5.20</td>
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<td>4.00</td>
</tr>
<tr>
<td>2014</td>
<td>1.00</td>
<td>4.30</td>
</tr>
</tbody>
</table>

### Improving and Preserving Genetic Progress

- **Preserving**
  - Focus on DOA’s, Calf mortalities, Fresh culls and deads
  - Goal from birth to fresh is 95%
  - Goal for <60 day culls and deads is 5.0%

- **Improving**
  - Stratify herd into genetic “donors” and “non-donors”
    - Non-donors
      - Beef crosses
      - Embryo surrogates  - Rent a Uterus
    - Donors
      - Sexed semen to meet herd needs
How much excess resource?

- With 90% survival, no sexed semen, 50% heifers and a 45% cull rate can be supported.
- Therefore, with a 35% cull rate, 30% of the heifer resource will be extraneous.
- How can that excess 30% be put to most profitable use?
- If my heifer resource is worth $2,244,350 I am talking about managing $673,305 for greater profit.
Make greater use of a strategic DNB program.

- Aggressive, focused DNB program
- Examples
  - >3 lact
  - Relv < 90
  - Mast/SCC
    - Save cost of tx and higher risk of reoccurrence
- This is the only tactic which doesn’t require a dry period (cost $250?)
- High value fat cull vs low value fresh cull (difference?)
- Best in a BST environment

Preferred Manure Producer

- Methane digester
  - Pathogen reduction
  - Odor reduction
  - Renewable power production

- Advanced manure processing
  - Explore new technologies
    - Nitrogen and phosphorus control
Discussion: Staying Ahead in the Dairy Business

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NOTES