Enhancing Fertility of Lactating Dairy Cows

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Introduction

The lactating dairy cow is not as fertile as she once was. And the likely culprit is not going to go away. But wait, there’s hope for ol’ Bessie. This story will outline the likely reasons for the decline of dairy cow fertility and discuss reproductive management methods to help alleviate this problem.

Infertility of the lactating dairy cow continues to be a critical problem limiting profitability and sustainability of dairy farms [1, 2]. Reproductive performance of lactating dairy cows is dependent upon service rate (or estrus detection rate), fertility of the service sire, and maternal fertility. Service rate can be controlled utilizing Ovsynch technology (Figure 1; [3, 4]). The majority of dairy producers in the U.S. regulate time to first and subsequent artificial inseminations (AI) with Ovsynch technology [5]. High fertility sires can be chosen utilizing the USDA-AIPL summaries sire conception rates. Yet, maternal fertility, defined as the mother’s ability to ovulate a competent oocyte and provide an oviductal and uterine environment capable of fertilization and complete embryonic and fetal development, continues to be the key limiting factor for successful reproductive performance in lactating dairy cows.

Conception rates of lactating cows are approximately 30% compared to 60% for virgin dairy heifers [4, 6] when inseminated following a detected estrus. Increasing conception rates of lactating cows to that of heifers would allow producers to employ the most profitable calving interval strategies for cows with different milk production levels. Aspects of maternal fertility that are limiting to conception and embryonic/fetal development are becoming better understood. Modifications to Ovsynch also are being developed to enhance maternal fertility while continuing to control service rate.

Why is Fertility Compromised in Lactating Dairy Cows?

Circulating concentrations of steroid hormones significantly change following the transition from heifer to lactating cow. Serum concentrations of progesterone and estrogen are reduced by about 50% in cows compared with heifers, even though the corpus luteum (CL; the structure in the ovary that produces progesterone) and ovulatory follicle (the structure in the ovary that produces estrogen and ovulates the egg) are larger in cows.

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Duration of estrus also is longer in heifers. This is likely due to greater amounts of estrogen in circulation compared with cows. The difference in progesterone appears to influence follicular growth by prolonging the age of the ovulatory follicle. Therefore, oocytes (eggs) from the ovulatory follicle of lactating dairy cows may have a lesser chance to be fertilized or develop into a competent embryo compared with oocytes of heifers which have greater concentrations of progesterone [7].

What is Causing the Differences in Progesterone and Estrogen Concentrations Between Lactating Dairy Cows and Heifers?

Wiltbank and co-workers at the University of Wisconsin-Madison found that feed dry matter intake differences of lactating dairy cows impacted on circulating concentrations of progesterone and estrogen [8]. These hormones are primarily metabolized in the liver. When dry matter intake was increased so was blood flow through the liver. Thus, the greater the blood flow through the liver, the greater the steroid hormone metabolism, resulting in less estrogen and progesterone remaining in circulation. The research suggests that lactation per se is not the root of the problem. The reduced hormone concentrations likely are associated with the large amounts of feed that lactating cows must consume to produce large quantities of milk.

How Can We Resolve this Problem?

Increasing circulating progesterone concentration during the growth of the ovulatory follicle is a key factor to increase fertility in lactating dairy cows. Cows with greater progesterone concentrations at the time of prostaglandin F2α (PGF) of Ovsynch have greater probability of pregnancy (Figure 2). Therefore, creating higher concentrations of progesterone during Ovsynch should compensate for the progesterone lost due to high metabolism by the liver of lactating dairy cows and enhance fertility.

Strategy to Increase Progesterone Concentrations at Time of PGF of Ovsynch

Multiple strategies previously have been tested to increase progesterone prior to PGF injection of Ovsynch. In studies that used a controlled progesterone releasing intravaginal device (or CIDR) to achieve greater concentrations of progesterone during Ovsynch, there was no significant increase in progesterone on the day of PGF injection of Ovsynch or in resulting conception rates of cycling cows [9]. Concentrations of progesterone in cycling cows with a CIDR were similar to cows without a CIDR (2.7 compared with 2.8 ng/mL) [9]. Thus, use of a CIDR may not be the best strategy to increase progesterone concentrations and enhance fertility in lactating dairy cows. We therefore examined the possibility that GnRH inducement of a second (accessory) CL during Ovsynch could be used to more effectively enhance progesterone concentrations. In this case, cows would have two CL during Ovsynch, an older CL and

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure2.png}
\caption{Predicted probability of pregnancy based on concentrations of progesterone (P4) at time of PGF administration in Ovsynch for cows with functional corpus luteum (CL) at time of treatment (n = 490).}
\end{figure}

*Predicted probability (chance) of pregnancy: 0.0 = 0%; 0.5 = 50%; 1.0 = 100%.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure3.png}
\caption{Description of control of follicle and CL development utilizing a simple PGF – GnRH pre-synchronization scheme (G6G). The initiation of Ovsynch on d 6 of the estrous cycle induces the ovulation of a dominant follicle (DF) and forms an accessory corpus luteum (CL) which increases progesterone (P4) prior to PGF of Ovsynch.}
\end{figure}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure4.png}
\caption{Description of control of follicle and CL development utilizing a simple PGF – GnRH pre-synchronization scheme (G6G). The initiation of Ovsynch on d 6 of the estrous cycle induces the ovulation of a dominant follicle (DF) and forms an accessory corpus luteum (CL) which increases progesterone (P4) prior to PGF of Ovsynch.}
\end{figure}
a younger CL (accessory CL). The idea was that this accessory CL would increase the production of progesterone and compensate for the lost by liver metabolism.

Cows had the greatest chance to ovulate a follicle and create a new accessory CL when they were on d 6 or 7 of the estrous cycle when the first GnRH of Ovsynch was administered. More than 90% ovulated a first wave dominant follicle and formed an accessory CL. When the PGF of Ovsynch was administered 7 d later, cows that ovulated had both a primary 13 or 14 d old CL and a 7 d old accessory CL. Cows with both CL (d 13 CL and d 7 CL) had correspondingly greater circulating concentrations of progesterone at time of the PGF of Ovsynch compared with cows that did not receive GnRH and only had a d 13 CL (5.22 vs. 3.53 ng/mL, respectively). Thus, presence of a young (d 7) accessory CL during Ovsynch positively impacted progesterone concentrations before artificial insemination (AI).

What is the Best Way to Ensure that Cows are on d 6 of Estrus Cycle at Time of 1st GnRH of Ovsynch?
To induce the accessory CL following the first GnRH of Ovsynch cows must be pre-synchronized (prior to Ovsynch) to ensure that cows are in a stage of the estrous cycle that has both a high probability of ovulation of a dominant follicle to the first GnRH and control of subsequent CL regression with PGF. In two previous studies [10], (published and unpublished data), we observed rate of induction of accessory CL at 4, 5, 6, 7, or 8 d of the estrous cycle at the time of the first GnRH of Ovsynch.

The “d 6” interval (referred to as G6G; Figure 3, page 2) resulted in a greater percentage of cows ovulating to the first GnRH and inducing accessory CL compared with the other intervals. If cows responded to both PGF and GnRH pre-synchrony treatments and were on d 6 of the cycle at time of first GnRH of Ovsynch, 97% of cows contained accessory CL, had a greater progesterone concentrations, and a greater probability of a pregnancy.

What Current Programs Seem to be Working the Best to Achieve Greater Conception Rates?
There are several programs that enhance fertility of dairy cows that utilize the technologies described above to enhance progesterone. We recommend three programs for first AI: Double Ovsynch [11], G6G [10], and Presynch-11 [12]. The recommended resynchronization programs (setting cows up for AI following a pregnancy diagnosis) are: G6G, GGGP (for cows without a CL at diagnosis), and an abbreviated Presynch-11 (see Calendars on page 23 for details).

Summary
This article provided a basis for the concept that low progesterone in lactating dairy cows due to enhanced steroid metabolism may be the underlying cause of the low fertility that has plagued dairy herds for the past 2 decades. We have developed synchronization strategies that partially solve this problem. Enhancing the percentage of cows that respond to the first GnRH of Ovsynch allows for more cows with accessory CL, greater concentrations of progesterone at time of induced luteolysis (PGF of Ovsynch), and a greater chance for pregnancy.
Breakfast on the Farm Changes Public Impressions

Ted Ferris, Faith Cullens, Marilyn Thelen, Dean Ross, Nancy Thelen, Mary Dunckel, and Phil Durst

Introduction

Breakfast on the Farm (BOTF) events in Michigan are connecting the public with modern agriculture and food production. We reported in the January 2011 issue of Michigan Dairy Review (MDR) that BOTF events in Michigan appear to be attracting the desired audience with 46% percent of respondents to our exit survey indicating they have not been on a dairy farm before and 25% percent indicating they have been on a dairy farm only 1 to 5 times. In addition, 45% live in an urban area; 42% live in a rural area, while only 14%, live on a farm.

To determine the key educational aspects of farm visits by the public, we surveyed BOTF participants. The focus of this article is on BOTF participants’ impressions about modern dairy farms and farmers. Do BOTF events change impressions and attitudes about modern dairy farms?

Impressions Count

Exit surveys were conducted at three BOTF events, in 2010 that involved dairy farms in Alpena, Clinton and Washtenaw Counties. Information from 546 completed surveys are summarized in this article.

Two survey questions were included to capture impressions before and after respondents’ BOTF experience to get an estimate of their perceptions about dairy farms and dairy farmers. The first question asked respondents to indicate their general impression before and after their visit on four statements listed in Table 1.

Values in Table 1 are averages based on a 5-point scale where 1 represents “Very Negative” and 5 represents “Very Positive”. During the walk around tour on each farm, signs, posters and individuals were stationed to provide the public with information on various aspects of modern dairy farms. Table 1 contains the average ratings before and after their visit with the changes in impressions. Averages increased from 0.71 to 0.85 points. Housing received the lowest rating before but had the greatest increase of 0.85.

<table>
<thead>
<tr>
<th>My general impression about</th>
<th>Before</th>
<th>After</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>How farmers care for the environment</td>
<td>3.93</td>
<td>4.67</td>
<td>0.74</td>
</tr>
<tr>
<td>How farmers treat food-producing animals</td>
<td>3.89</td>
<td>4.66</td>
<td>0.77</td>
</tr>
<tr>
<td>The safety of milk</td>
<td>4.06</td>
<td>4.77</td>
<td>0.71</td>
</tr>
<tr>
<td>Housing provided for dairy animals</td>
<td>3.84</td>
<td>4.69</td>
<td>0.85</td>
</tr>
</tbody>
</table>

Based on the distribution of responses for impressions before and after the BOTF visit for “Housing provided for dairy animals”, the percentage of “Very positive” responses increased from 33 to 71%, with only 2 of 16 remaining “Very negative”, and 5 of 32 remaining “Negative”. Similar distributions occurred for the other three aspects. In general, the number of individuals who rated these four aspects “Very Positive” doubled between “Before” and “After” their visit. The number of combined “Very negative” and “Negative” responses decreased from 33 to 3 for “How farmers care for the environment”; from 44 to 5 for “How farmers treat food-producing animals”; and, from 34 to 0 for “Steps to safeguard milk”. In addition, 12 of the 25 who responded “Negative” before for “How farmers care for the environment” responded “Very positive” after their visit. Similar results occurred for the other three aspects indicating that the BOTF visits markedly changed responses for those having negative perceptions before their visit.

Does “Where they Live” Influence their Impression?

Respondents were asked where they currently live. There were 159 respondents living in an urban area; 90 in an urban area near a farm; 65 in a rural area not near a farm; 157 in a rural area near a farm; and 74 on a farm. Results indicate those living in urban and rural areas not near farms had similar impressions before their BOTF visit and lower impressions than individuals living near a farm in either urban or rural area. Those living on farms had the best impressions before their BOTF visit, which we would expect.

The best impressions (rating) before a BOTF visit by urban visitors not living near a farm were for “Steps to safeguard milk” (3.73) and their worst rating was for “Housing provided for dairy animals” (3.44). However, their impressions about housing im-
proved the most as a result of BOTF (+1.10 rating points). Visitors from rural areas not near a farm had the greatest increase in rating for “How producers treat animals” (+1.02) and “Steps to safeguard milk” (+1.01). The increase in ratings for those who live on a farm were one-third to one-half the increase for those not living on a farm. One would expect little change for those living on a farm; however, this group may include individuals who live on another type of farm or perhaps non-working farms and therefore were less familiar with dairy farms.

Number of Prior Visits: First Impressions
One way to evaluate how much understanding visitors have about modern dairy farms is to look at the number of visits they have made to dairy farms. As mentioned, 47% of respondents were first-time visitors to a dairy farm. The average response “Before” increased with the number of prior visits to a dairy farm, meaning those more familiar with dairy farms have better impressions. First-time visitors had the best perceptions about “Safe guards for milk” and worst perception about “Housing provided for dairy animals”. While lower ratings were given by respondents with fewer visits, these groups showed the greatest improvement in their impressions or ratings on the 5-point scale.

General Impact of BOTF Visits
Three questions were asked to get a general idea from participants about what they felt the impact of BOTF was for them. They were asked how strongly they agree with the three statements found in Table 2. Eighty-five percent of respondents “Strongly Agreed” that “Breakfast on the Farm is a good way to connect the public with modern food production”, 10% “Agreed”, while only 1.6% “Strongly Disagreed” to this statement. The average response was 4.78 on the 5.0-scale.

In addition, 78 or 17% of respondents “Strongly Agreed” or “Agreed” that as a result of the tour, they “have a better understanding of modern dairy production”. The average response was 4.71. Alpena Co. had a higher combined percentage of those who “Strongly Agreed” or “Agreed” (91+7%) compared to Clinton Co. (70 + 20%) and Washtenaw Co. (76 + 19%). In the previous MDR article we reported that Alpena Co. had a greater percentage from a rural area for both near and not near a farm while Clinton and Washtenaw Counties had a greater percentage from an urban area near a farm. This may be contributing to the noted differences.

For the third statement, the average response was 4.66 and 78% and 15% “Strongly Agreed” or “Agreed” that their “General impression about modern dairy farming has improved” as a result of their visit. Again, Alpena Co. had a higher combined percentage for those who “Strongly Agreed” or “Agreed” (92+5%) compared to Clinton Co. (71 + 21%) and Washtenaw Co. (75 + 16%).

Summary
Visits to BOTF events by the public are having an impact on their impressions about modern dairy farms and are helping to build trust. Exit survey results presented show that overall average ratings for “How farmers care for the environment” changed from 3.93 to 4.67 (+0.73) on a 5-point scale; from 3.89 to 4.66 (+0.77) for “How farmers treat food-producing animals”; from 4.06 to 4.77 (+.71) for “The steps to safe guard milk”; and, from 3.84 to 4.69 (+.85) for “Housing provided for dairy animals”. Respondents’ prior perceptions were greatest for “Steps to safe guard milk” and least for “Housing provided for dairy animals”.

Respondents living in urban and rural areas not near farms had similar impressions before their BOTF visit but lower impressions than individuals living near a farm in either urban or rural areas. However,

Table 2: Percentage distribution of responses for three impact questions.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Average Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOTF is a good way to connect the public with modern food production</td>
<td>1.6</td>
<td>0</td>
<td>2.9</td>
<td>10.3</td>
<td>85.1</td>
<td>4.78</td>
</tr>
<tr>
<td>I have a better understanding of modern dairy production</td>
<td>0.9</td>
<td>0.5</td>
<td>3.6</td>
<td>16.8</td>
<td>78.1</td>
<td>4.71</td>
</tr>
<tr>
<td>My general impression about modern dairy farming has improved</td>
<td>1.5</td>
<td>1.3</td>
<td>4.9</td>
<td>14.7</td>
<td>77.6</td>
<td>4.66</td>
</tr>
</tbody>
</table>
Elwood Kirkpatrick Dairy Science Research Endowment: A Completed Project

The Elwood Kirkpatrick Dairy Science Research Endowment was started in 2007 to honor the work and support of Mr. Elwood Kirkpatrick for the dairy industry of Michigan and Michigan State University. The Endowment along with partnership support from the Department of Animal Science, Michigan Milk Producers Association, the Clinton E. Meadows Endowment, the College of Agriculture and Natural Resources, and Michigan AgBioResearch (formerly Michigan Agricultural Experiment Station) has partially funded several MSU dairy research projects addressing a wide range of topics. Reported in this issue is the summary of a completed project.

Michigan Bovine Leukosis Study

Main Participants: Ronald Erskine, Paul Bartlett, Lorraine Sordillo, Chelsea Render, Catherine Febvay, Dept. of Large Animal Clinical Sciences, and Todd Byrem, AntelBio Inc., East Lansing, MI.

Background

Bovine leukosis is a contagious disease of cattle caused by Bovine Leukemia Virus (BLV). The disease is characterized by a persistent leukemia, which can culminate in malignant lymphosarcoma [Schwartz and Levy, 1994]. The National Animal Health Monitoring System (NAHMS) determined that BLV is present in 89% of US dairy operations [USDA-APHIS, 1997]. Only 30 to 40% of BLV carriers will develop leukemia, while less than 5% develop malignant lymphosarcoma [Schwartz and Levy, 1994]. A later study determined the incidence of lymphosarcoma was 6 to 7 cases/yr/1,000 cows if the herd prevalence of BLV was 50% [Rhodes et al., 2003]. Because BLV seldom causes outward clinical signs of leukemia, the effects of BLV infection on overall bovine health and productivity are believed to be relatively minor when only malignant lymphosarcoma is considered, although this depends on the proportion of cows infected in a herd. When lymphosarcoma develops, the clinical signs are largely a function of the organs that are invaded by the malignant cells, often the spinal column, uterus, heart, and abomasum.

However, the possibility that the disease can cause less obvious changes in dairy cattle productivity is controversial. Early studies found no influence on milk production, incidence of mastitis, or reproductive performance [Jacobs et al., 1991]. In contrast, other studies reported negative effects of BLV infection on reproductive performance, milk production, and in particular, longevity [Pollari et al., 1993; Brenner et al., 1989; Pelzer, 1997; Ott et al., 2003]. It is probable that the negative effects of BLV on milk production and reproduction are reduced by early culling of poor-performing infected cows, and therefore the major effect of BLV in many herds may be primarily realized by reduced cow longevity. As part of the USDA-NAHMS 1996 dairy study, the estimated average reduction in productivity was approximately $59/cow for BLV test-positive herds [Ott et al., 2003]. A Virginia study suggested a loss of over $400/case of lymphosarcoma; however, subclinical cost was $64/cow per yr in herds with a BLV prevalence of 50% [Rhodes et al., 2003].

To further our understanding of this disease, we surveyed 113 Michigan dairy herds in the summer of 2010 to determine what herd management practices may be associated with herd prevalence of BLV infection. The preliminary results are described below, and suggest the herd risk factors for infection are complex.

Michigan Field Study

We randomly selected 113 dairy herds in Michigan based on the following criteria:

1) participated in regular DHIA testing;
2) had at least 120 cows on test; and,
3) willingness to participate.

Herd were visited once during the summer of 2010 to complete a survey regarding facilities, history, and management practices. Additionally, DHI technicians collected milk samples during one routine test day for submission to the laboratory (AntelBio) for ELISA testing of BLV antibodies. We designed a herd profile as a practical method to estimate the herd prevalence of BLV-infected cows and the relationship of age to infection.

For the profile, we collected 40 milk samples per herd on the study; 10 samples each from first, second, third, and fourth or greater lactation cows. We also selected cows that recently calved, based on calving dates recorded from the previous month test date. To validate the BLV herd profile, we compared BLV milk ELISA with serum ELISA in 142 cows, and compared our profile sample size with whole herd milk ELISA in four herds. We determined that there was a 95% agreement between BLV milk and serum ELISA. Finally, with profile testing, we estimated herd prevalence of BLV-infected cows consistent with that obtained from whole herd testing.

The percentage of BLV-infected cows in herds ranged from 0% to...
76%. The prevalence of infection in first-lactation cows (18%) was less than third-lactation and greater cows (42%). This may reflect the slow progression of the disease and/or exposure to transmission risks, e.g., through more frequent injections of adult cattle vs. heifers. Higher risk of BLV infection also was associated with larger herds, especially those that added replacement animals in the last 3 years.

We determined that higher prevalence of BLV infection in herds was associated with lower milk production per cow (annual rolling herd average basis), which agrees with previous research. Herds with higher prevalence of BLV infection had significantly lower proportions of older cows (third lactation or greater), which suggests that increased prevalence of BLV infection is associated with decreased longevity. Risk factors associated with the transmission of BLV are related to exposure of blood from infected animals. Thus, shared needles, palpation, tattoo pliers, dehorning, and to a lesser extent, nasal discharges, colostrum, and flies, all have been incriminated as sources of infection. Analysis of our survey data could not determine any single management practice that was significantly associated with increased risk of BLV infection. This suggests that the control of this disease is complex, and will result from multiple management practices that are part of a comprehensive herd plan.

Summary
Bovine leukosis is a disease that progresses slowly, and is often subclinical in presentation. Only a small percentage of cows infected with BLV develop lymphosarcoma. Milk production and longevity have been cited as potential losses from BLV infection. Our study supports this concept. Older cows and herds that have added replacement animals are at a higher risk of infection. Identifying single herd management practices that are associated with decreased risk of infection is difficult, and eventual control of this disease within a herd likely will be accomplished from a comprehensive plan of testing and management. We will continue to evaluate the survey data to update the results at a later date.

View complete list of references in the web version at http://www.msu.edu/user/mdr/.

Breakfast on the Farm...
Continued from Page 5
their impressions improved the most as a result of BOTF. Improvement in impressions was the greatest for those with fewer prior visits, meaning BOTF has more positive impact on those who have not been on a dairy farm before.

When asked how their visit impacted them, a large percentage of respondents “Strongly Agreed” with these statements: “Breakfast on the Farm is a good way to connect the public with modern food production” (85%); “as a result of the tour, they have a better understanding of modern dairy production” (78%); and “their general impression about modern dairy farming has improved” (78%) as a result of their visit.

And finally, when asked if BOTF is a good way to connect the public to modern food production “Family member of farm owner or farm employee” had an average response of 4.83; “Dairy farm employees” responded with a 5.00; “Dairy farm owner/operator” average was 4.73; and, those “Working in ag-related field” had an average of 4.91, indicating that these groups felt BOTF is a worthy effort.

These BOTF events are a collaborative effort between MSU Extension and County Farm Bureau with significant personnel and financial support from the agri-business sector. United Dairy Industry of Michigan (UDIM) provided funding for data entry for this survey.
An Important Lesson in Milk Marketing

Craig Thomas
Extension Dairy Educator, Michigan

Calendar year 2009 was very difficult for Michigan dairy producers. According to data collected by Michigan State University, the average gross cash margin for Michigan dairy producers was $1.83/cwt in 2008 and plummeted to -$1.81/cwt in 2009. As a result, profits fell, accounts payable soared, and large slices of equity evaporated. Average annual Class III milk price fell 35% from 2008 to 2009 ($17.44/cwt to $11.36/cwt). Perhaps the most unfortunate aspect of this situation was that if Michigan dairy producers had employed moderate and conservative milk marketing strategies in 2008, they could have avoided some of this financial disaster.

At the beginning of 2008 the annual average Class III futures price for 2009 at the Chicago Mercantile Exchange (CME) was $15.73/cwt (Figure 1). As indicated in Figure 1 this average futures price continued a steady climb peaking at $20.65/cwt on June 18, 2008. Hindsight is 20/20, but theoretically it would have been possible on June 18, for a dairy producer to have forward contracted 2009 milk production and received $9.20/cwt greater milk price than what was eventually received ($11.36/cwt Class III average). Every experienced marketer knows that hitting that high is very unlikely. Also, hitting the high is not the goal of a realistic marketing plan. A realistic plan takes into account the cost of producing milk and whether milk prices in the futures market are offering a realistic margin over that cost. When the market is offering a positive margin and is continually strengthening, as it did for 2009 Class III milk prices during much of 2008, a strategic marketer could have “sold into a rising market.”

One way to determine whether the futures market is offering truly attractive milk prices is to look at Class III milk prices from a cumulative probability perspective. Figure 2 (on page 9) is a cumulative probability graph of actual monthly Class III milk prices from 1995-2010 (before 2000 Class III was designated as the Basic Formula Price or BFP).

The horizontal axis of Figure 2 is price, and the vertical axis represents percentiles (i.e., cumulative probability). The curved line begins on the left at the lowest monthly Class III price during that time period, $8.57/cwt (November 2000), and ends on the right at the highest monthly Class III price, $21.38/cwt (July, 2007).

As you move from left to right along the curved line you are simply placing each actual monthly Class III price in order of increasing magnitude. Thus, during that time period 100% of monthly Class III milk prices fell between $8.57/cwt and $21.38/cwt. The average was $13.20/cwt and the 50th percentile was $12.83/cwt. So 50% of the Class III prices were below $12.83/cwt.

A Class III price of $16.94/cwt is at about 90th percentile. This means that from 1995-2010 the monthly Class III price was only higher than $16.94/cwt 10% of the time. Recall that the CME Class III futures average for 2009 peaked on June 18, 2008 (Figure 1), however, that price remained at, or above, the 90th percentile ($16.94/cwt) from March 7, 2008 to September 09, 2008 as shown by the horizontal line at $16.94/cwt on Figure 1. Thus, dairy
producers had over 6 months in which to sell all 2009 milk on the futures market, or use forward contracting, at extremely attractive prices. Therefore, I would advise dairy producers to strongly consider forward selling milk anytime the annual average Class III futures price hits the 90th percentile. This does not mean a producer would sell 100% of future milk production when the Class III price hits this point. Rather, producers can use this price level as a point to trigger a marketing plan into action. Such a plan sets price trigger points for small portions (e.g., 10 to 30%) of annual production as the market peaks and declines.

If a dairy producer had used this strategy in 2008 for selling 2009 milk production, the results would have been dramatically beneficial. For instance, assume that the “average” Michigan dairy producer forward contracted 50% of his/her 2009 production at or above the 90th percentile as the futures market rose and fell during the summer of 2008. Assume also that the average Class III price of milk marketed in the future was halfway between $16.94/cwt and $20.65/cwt. Ultimately, the forward contracted milk would have sold for $18.80/cwt (Class III). This would have increased the average price (Class III) of all milk sold by the farm to $15.08/cwt, an increase of $3.72/cwt.

The average Michigan dairy herd in 2009 had about 162 cows, producing about 22,445 lb/cow. This marketing strategy would have produced over $135,500 more total revenue for 2009. Ironically, the 2011 CME Class III futures average was $16.94/cwt on February 25, 2011.

Have you considered a marketing plan to sell some 2011 milk ahead?

“A realistic plan takes into account the cost of producing milk and whether milk prices in the futures market are offering a realistic margin over that cost. When the market is offering a positive margin and is continually strengthening, as it did for 2009 Class III milk prices during much of 2008, a strategic marketer could have sold into a rising market.”
For many years we have said that it was important to consider feed costs as part of dairy farm risk management planning. That is, locking in milk price without having a handle on feed price, could result in being squeezed if feed prices unexpectedly increase. The volatility of the past 4 or so years makes this even more important.

Consider Figure 1 which displays the margin between milk price and feed price using US all-milk price as well as Chicago Board of Trade (CBOT) corn and soybean meal monthly average price and NASS average alfalfa hay price. The feed quantities are those used by National Milk Producer’s Federation in their margin protection plan. Over the almost 11-year period, the margin averaged $7.66/cwt. There was a great deal of volatility in the value which peaked at $13.77/cwt and had a minimum of $1.26/cwt. There were only 9 months that were below $4/cwt, but all of them occurred in 2008 and 2009.

We are again in a feed price situation similar to 2007 and 2008 with corn currently near $7/bu for July 2011 on the CBOT. Carryover stocks of grains are tight, cash land rents have increased, and many important planting decisions will be made in the next couple of months.

A number of tools are available to dairy farmers that might make sense to consider in managing milk and feed prices. These include forward contracts through dairy cooperatives and futures and options for milk. Similarly feed prices often can be locked in using these same set of tools.

Another possibility is the dairy-livestock gross margin (dairy-LGM) insurance which is essentially a set of bundled options that can lock in a margin. Dairy-LGM is available on the last Friday of each month. It uses the Class III milk as well as corn and soybean meal futures and options price data to calculate the implied distribution of the margin between milk and feed prices. Farmers select quantities of corn and soybean meal within certain boundaries. Farmers also select the deductible with a government premium subsidy.

If you are locking in both milk and feed prices, consider that there are still risks involved—even if all of the milk production and feed use is covered (which would not normally be the preferred quantities). The risk for milk basis, the difference between the Class III futures price and your mailbox milk price, would not be covered.

Since the mailbox milk price includes the pool value (e.g., Class I price times Class I utilization),
as well as over-order and quality premiums, we expect the basis to be positive. In Michigan, the average basis over the past 10 years has been about $1.05/cwt with a considerable range above or below the average for monthly basis values.

Thus, when using milk risk management tools related to Class III price, farmers still have basis risk. Similarly, basis risk exists for corn and soybean meal where we expect negative basis.

Finally, the margin between milk and feed price is what is left to pay for all other expenses including unpaid management, labor and capital. Table 1 displays the top 10 dairy-related farm cash expenses from 2005-2009.

Note that a couple of the expenses are almost certainly used for field crops on many farms (i.e., fuel and custom hire) but the primary enterprise on these farms was dairy so much of these crops were fed. The largest cash expense was for purchased feed. The value of home-grown feed (not displayed in the table) averaged $5.32/cwt of milk produced for 2005-2009. Many of the other cash expenses beyond feed are generally not too volatile. The exception is likely energy costs in the form of fuel (5th) and utilities (9th). Another increasingly important expense has been interest which might reflect the need for operating loans to alleviate cash flow considerations.

“We are again in a feed price situation similar to 2007 and 2008 with corn currently near $7/bu for July on the CBOT. Carryover stocks of grains are tight, cash land rents have increased, and many important planting decisions will be made in the next couple of months.”

Table 1: Top Ten Dairy Farm Cash Expenses, 2005-2009.

<table>
<thead>
<tr>
<th>Expense</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Purchased Feed</td>
<td>4.06</td>
<td>3.74</td>
<td>5.32</td>
<td>5.56</td>
<td>4.56</td>
<td>4.65</td>
</tr>
<tr>
<td>2 Hired Labor</td>
<td>2.30</td>
<td>2.23</td>
<td>2.67</td>
<td>2.84</td>
<td>2.59</td>
<td>2.53</td>
</tr>
<tr>
<td>3 Repairs</td>
<td>1.33</td>
<td>1.07</td>
<td>1.59</td>
<td>1.50</td>
<td>1.29</td>
<td>1.36</td>
</tr>
<tr>
<td>4 Interest</td>
<td>0.88</td>
<td>0.95</td>
<td>1.38</td>
<td>1.27</td>
<td>1.18</td>
<td>1.13</td>
</tr>
<tr>
<td>5 Fuel and Oil cap</td>
<td>0.84</td>
<td>0.89</td>
<td>1.22</td>
<td>1.38</td>
<td>0.94</td>
<td>1.05</td>
</tr>
<tr>
<td>6 Marketing/Trucking</td>
<td>0.82</td>
<td>0.81</td>
<td>0.83</td>
<td>0.90</td>
<td>0.90</td>
<td>0.85</td>
</tr>
<tr>
<td>7 Livestock Supplies</td>
<td>0.80</td>
<td>0.69</td>
<td>0.94</td>
<td>0.78</td>
<td>0.80</td>
<td>0.80</td>
</tr>
<tr>
<td>8 Custom Hire</td>
<td>0.48</td>
<td>0.52</td>
<td>0.79</td>
<td>0.69</td>
<td>0.63</td>
<td>0.62</td>
</tr>
<tr>
<td>9 Utilities</td>
<td>0.46</td>
<td>0.47</td>
<td>0.62</td>
<td>0.63</td>
<td>0.65</td>
<td>0.57</td>
</tr>
<tr>
<td>10 Veterinary/Medicine</td>
<td>0.46</td>
<td>0.48</td>
<td>0.60</td>
<td>0.53</td>
<td>0.50</td>
<td>0.51</td>
</tr>
</tbody>
</table>

Source: MSU Michigan Dairy Farm Business Analysis Summaries.
Efficient Liquid Manure Transport and Land Application

Tim Harrigan
Dept. of Biosystems and Agricultural Engineering

In recent years dairy farms have grown in size and efficiency. When more livestock are housed in one location, the volume of stored manure and the manure hauling distance to reach the land base needed for application also increase. Manure agitation, pumping, transport and land application typically cost $100-$160/cow per yr for a Michigan dairy farm. Because hauling and land application greatly impact labor needs and must align with tillage and planting plans, many farm managers are custom-hiring manure hauling services. We recently completed a study of labor, machinery and manure hauling rates (gal/hr) for custom applicators using 13 hauling systems on 10 farms in Michigan, Ohio and Ontario.

Tank Spreaders and Travel Time
When tank spreaders were used for over-the-road transport and land application they typically needed about 14 minutes plus travel time for each load. When hauling to fields near manure storage, applicators applied three to four loads per hour, but the hauling rate declined by 20%, 40% and 50% with one-, two-, and three-mile hauls, respectively (Figure 1).

The most effective way to increase the hauling rate was to increase the size of the spreader tank and increase transport speed. Speed and tank volume became more important as the hauling distance increased. For instance, increasing tank capacity 20% (e.g. from 7,000 to 8,400 gal) increased hauling capacity 8% near the pit, 13% with a 3-mile haul, and 15% with a 5-mile haul. A 20% increase in travel speed had little effect when hauling to fields near storage but increased hauling capacity 8% with a 3-mile haul and 11% with a 5-mile haul. Increasing the loading rate at the pit or increasing the injector flow rate by 20% increased hauling capacity about 4% when hauling near the pit, and 2% with a 5-mile haul.

Manure handling equipment has evolved to transporting and applying manure quickly and efficiently. Large spreader tanks, in-field holding (frac) tanks, nurse trucks with boom extensions, and high-capacity pit and spreader pumps have reduced the time needed for loading, unloading, transport and land application. Custom applicators who we observed used tank spreaders ranging in size from 6,000 to 10,000 gal and tractors with speeds ranging from 25 to 40 mph. Semi-tractors with nurse tanks averaged 31 mph fully loaded, and 35 mph when empty.

Flow and Unloading Rates
High-capacity manure pumps and pump agitators were available, but seldom used at full capacity because high flow rates can cause foaming in the spreader tank and in some cases pipe stands become unstable at high flow rates. The greatest flow rates were used for pit agitation. A typical pumping rate for tank spreader loading at the pit was 1,900 gal/minute (gpm).

Depending upon how the slurry was applied, spreader unloading rates ranged from about 900 to 3,000
gpm. The lower rate was with a 6-pt injector when the flow rate was controlled by a hydraulically-driven pump to achieve an agronomic rate of 7,000 gal/acre. The high rate was a broadcast application with a 9,500-gal tank spreader. A typical spreading rate was 2,500 gpm for broadcast application and 225 gpm/injector shank for injection. Injection units had five or six shanks, but one custom applicator used a nine-shank injector to increase spreading capacity.

The time needed to maneuver and position tank spreaders near the pit and in the field ranged from 5 to 7.5 minutes when hauling over-the-road from the storage pit to the field. Maneuvering time was reduced to 3 to 6 minutes when the tank spreaders remained in the field and were serviced by nurse trucks. Nurse trucks and truck-drawn spreaders needed more time for maneuvering and positioning in the field and at the pit, ranging from 4 to 9 minutes/load, total.

**Summary**
Manure land application may be a time-consuming task that can conflict with the timeliness of spring planting or be delayed until fall field and weather conditions are suitable for application. The capacity of tank spreaders declines with increased haul distance from storage to field.

Custom applicators generally have access to large tank spreaders, high-speed tractors, in-field frac tanks, nurse tanks with boom extensions, high-capacity pit pump/agitators and other equipment, and technologies that can improve hauling efficiency and improve productivity. The use of custom hauling services may be a good business decision for many dairy producers.

For more information about the on-farm study of involving custom manure applicators please refer to: Tim Harrigan, Biosystems and Agricultural Engineering, E-mail: harriga1@msu.edu or Phone: 517-353-0767 [Link]

John Partridge
Dept. of Food Science and Human Nutrition

Introduction

Since writing the original article found in Michigan Dairy Review in 2005 (1), there have been few changes in the debate over the benefits of consuming raw milk. However, there have been some important developments in the information available and discussion of the topic. In the State of Michigan, a workgroup was formed that has tried to discuss the future of raw milk. The Michigan Fresh Unprocessed Whole Milk Workgroup (2) has been addressing the question: Where do we want to be in 3 to 5 years on access to fresh unprocessed whole milk?

The group started meeting in 2007 and consists of “consumers who seek to ensure access to raw milk; producers who want to provide a healthy source of raw milk; grade ‘A’ milk industry representatives; and, food safety regulators who are looking to balance access and choice issues with protection of the food supply.” A visit to their website (http://www.miffs.org/MIfuwmilk/index.htm) indicates that the discussion is a long way from complete and still open to controversial interpretation of anecdotal testimony vs. science. In the meantime cow-share programs have increased. As consumers embrace this approach to obtaining raw milk it becomes more important that the facts are provided.

Information from Website

A relatively new website was started in 2009 after meetings of the American Veterinary Medical Association (3) and the International Association for Food Protection (4) that discussed emerging issues related to increased consumption of raw milk. The “Real Raw Milk Facts” (5) workgroup has constructed an excellent site that is open to both science and policy regarding raw milk. The web site is dedicated to providing evidence-based information on raw milk. The members of the workgroup are clearly identified. The scientists and educators represent a broad spectrum of dairy/food safety experts from universities, government agencies, industry and professional organizations.

Although the site is strongly in favor of pasteurization, raw milk advocates are given opportunity to make comments and share their perspective. The Real Raw Milk Facts website covers news reports from around the country regarding raw milk. There is an excellent “Question and Answer” page that provides a balanced presentation of the supported facts. Pages for related links; commentaries; position statements from academic, professional and regulatory associations; presentations; scientific references; and outbreak data, provide a large amount of well-supported information. A page covering regulations is promised in the future.

Raw vs. Pasteurized Milk

As with any food, there is some level of risk associated with the consumption of both raw and pasteurized milk. Data and references cover outbreaks in pasteurized milk and milk products as well as raw milk and its derivative products. The most telling statistics show that from 1973 to 2006, 70% of the outbreaks of food-borne illness were related directly to the consumption of raw (unprocessed) milk and its derivative products, while during that same period only 1 to 3% of the milk drinking population was drinking raw milk. There is no getting around the fact that drinking raw milk has a higher risk than drinking pasteurized milk.

Many raw milk advocates have balked at the epidemiological evidence that has connected outbreaks to farms, but one cannot ignore the strength of the evidence collected in an outbreak in Minnesota. Using a procedure called pulsed-field gel electrophoresis (PFGE), health investigators can now determine the DNA fingerprint of specific organisms.

As of June 10, 2010 there were eight individuals who were confirmed to have been made ill by a specific strain of E. coli 0157:H7 that had not previously been isolated in Minnesota (6,7) where the sale of raw milk is limited to direct farm purchases. The specific strain causing the illness has been isolated in 26 animal and environmental samples from the farm that produced raw milk consumed by each individual. The producer has claimed that the health department has no evidence that his product caused the illness because none of the products tested to date contain the organism. However, since the individuals had not been to the farm, the fact that their only common activity was consuming...
Thumb \( \text{H}_2\text{O} \) Project: Part 2, Water Treatment Options

Craig Thomas
Extension Dairy Educator, Michigan
David Beede
Dept. of Animal Science

Part 1 of this series (Vol 16, No. 1, January 2011) noted the importance of drinking water for dairy cattle. By weight, water is the most important nutrient in a milking cow’s ration, easily making up greater than 80% of total intake by weight. That article focused on the chemical and mineral composition of drinking water. We hope you have been motivated to have your farm’s drinking water tested for the constituents most often leading to water quality issues: total dissolved solids (TDS), sulfate (\( \text{SO}_4 \)), chloride, (Cl), iron (Fe), and nitrate-nitrogen (NO\(_3\)-N).

Further water testing and/or treatment should be considered if the above named constituents are greater than certain acceptable levels (see Table 1). At higher levels the constituents may negatively affect animal health and/or milk production, interfere with the germicidal activity of cleansers and sanitizers (e.g., chlorine), and cause problems with water system components (e.g., pipes and pumps). In fact, some water quality problems like excess iron can lead to such poor animal performance (e.g., health problems, reduced milk production) that it can be a “business-breaker” (2).

Table 1: Retest and actionable levels of important water constituents.

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Retest Level, ppm</th>
<th>Actionable Level, ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Dissolved Solids (TDS)</td>
<td>&gt;500</td>
<td>&gt;5,000</td>
</tr>
<tr>
<td>Sulfate (( \text{SO}_4 )) + Chloride (Cl)</td>
<td>&gt;250</td>
<td>&gt;500</td>
</tr>
<tr>
<td>Nitrate-nitrogen (NO(_3)-N)</td>
<td>&gt;10</td>
<td>&gt;20</td>
</tr>
<tr>
<td>Iron (Fe)</td>
<td>&gt;0.15</td>
<td>&gt;0.3</td>
</tr>
<tr>
<td>pH</td>
<td>&lt;6.5 or &gt;8.0</td>
<td>&gt;6.5 or &gt;8.5</td>
</tr>
</tbody>
</table>

High levels of some constituents (e.g., iron, nitrate-nitrogen) also can endanger human health if people are drinking from that water source (1). If levels of these constituents reach “retest levels”, further testing is warranted and one should even consider sending multiple samples to multiple certified laboratories to confirm/deny whether these constituents are truly problematic. If on further testing a constituent reaches or exceeds “actionable levels” dairy producers should seek help regarding water treatment options for their system’s drinking water.

Conclusion
Milk is harvested in an environment that presents inherent risks that can only be reduced rather than eliminated and having never found a pathogen on a farm in previous testing does not prevent a pathogen from finding its way onto the facility and into the product. Possible vectors for introduction of a pathogen may include insects, birds, animals, airborne soils and humans. You cannot see bacteria. So why take the chance with the health of your family when there is a safer alternative that is essentially equivalent from a nutritional perspective in pasteurized milk? View complete list of references in the web version at http://www.msu.edu/user/mdr/.

This raw milk does not allow for any reasonable doubt in this case. A second outbreak involving two hospitalizations of children and 30 confirmed illnesses has been linked to a goat milk dairy by the Boulder County Public Health Department (8). Both Campylobacter and E. coli 0157 bacteria were isolated and confirmed in the Colorado outbreak. Raw milk may not be sold legally in Colorado; however, a share program allows a consumer to own a share in a goat, which then allows the consumer to acquire a share of the milk produced on the farm.

The Minnesota and Colorado cases clearly point out the ability of pathogenic bacteria to contaminate milk without any realization that the contamination has taken place. Neither the producer nor the consumer can detect the presence of bacteria of any type without laboratory testing. Good sanitation practices during the harvesting of milk will reduce the possibility of contamination, but cannot eliminate the risk completely.
Water Treatment Options

Water treatment options vary depending on the water quality issue involved. A major difficulty in treating drinking water on dairy farms is posed by the huge volumes of water involved. Recall that a high-producing dairy cow may consume up to, or even greater than, 50 gal/day. Multiplying this use over hundreds, or thousands of cows, quickly results in a staggering daily volume of water that requires treatment. Thus, one of the best water “treatment” options may be finding an alternate water source that isn’t plagued by the offending constituent (2).

Other water treatment options include distillation (too costly), reverse osmosis (RO), ion exchange resin system (traditional water softener employing salt), oxidation + filtration via aeration (often called an “iron curtain”), and hydrogen peroxide ($H_2O_2$) injection systems (2).

Removal of excess TDS and excess sulfate + chlorine usually employs traditional water softeners or RO systems. Reverse osmosis systems remove 80 to 90% of these constituents depending on their design. Conventional water softeners are effective, but not designed to handle large volumes of water and require an acceptable place to dispose of the brine flush water needed to recharge the system.

Designing a Water Treatment System

Depending on the number of animals served, it may be necessary to design a water treatment system in such a way that large volumes of treated water can be stored for use at times of peak demand (2).

Oxidation systems are mainly used to remove excess iron from cattle drinking water. The “iron curtain” system employs aeration to convert the iron to a precipitate ferric ($Fe^{3+}$) form, which is then subsequently filtered from the water.

The hydrogen peroxide ($H_2O_2$) system involves the Fenton Reaction which converts iron from $Fe^{2+}$ (soluble in water) to $Fe^{3+}$ (insoluble in water) that can then be filtered out the $Fe^{3+}$ as a precipitant. This system injects $H_2O_2$ into the drinking water (8 oz of 35% $H_2O_2$ per 1,000 gal of water) and is quite cost-effective. A suitable injection pump costs around $500 and the cost of 15 gal of 35% $H_2O_2$ solution is about $100 (enough to treat ~240,000 gal of water).

When working with water treatment vendors it is absolutely essential they understand the following items about your farm’s situation (2).

1. Do they know how much water your dairy farms uses? More than likely your dairy uses much more water per day than the typical water treatment professional is accustomed to. There is a short paper, *Estimating Water Usage on Dairy Farms*, that helps producers understand the volume of water needed on a modern dairy farm. The paper also has an accompanying spreadsheet that producers can use to estimate daily water needs on their operations. To get a copy of the paper and/or the spreadsheet, send an e-mail to thomasc@msu.edu or download them from the MSU Extension Dairy Team web site ([www.dairyteam.msu.edu -> Nutrition -> Water -> Estimating Water Usage on Dairy Farms (paper) or Estimating Water Usage on Dairy Farms (spreadsheet)]).

2. What is the treatment rate (volume/time) of the water treatment company’s system? Again, your dairy will most likely consume water at rates, particularly at peak demand periods, which typical water treatment professionals are unfamiliar. Can their system keep up and provide enough treated water to meet your peak demand?

3. Does the water treatment provider guarantee their system will meet peak demand and reduce the undesirable constituent to acceptable levels? Will their system meet this requirement throughout the expected useful life of the system? Are they willing to provide such guarantees in writing?

4. What is the expected useful life of their system and what are their system’s maintenance requirements and costs? Who is responsible for maintenance—you or them? Do they offer a service contract, and if so, what does it cost and what does it cover?

5. What chemicals (e.g., other mineral elements) does their system/method add to the water and at what concentrations? They may add nothing, but some systems add significant amounts of constituents (e.g., chlorine) that may cause an entirely new set of problems.

6. Ask potential water treatment providers to allow you to contact other customers that use their system. Visit these other installations of this provider’s system to determine whether their products, services, and warranties are as good as advertised. Do not do business with any water treatment provider not willing to provide you this information.

We recommend that you routinely send samples of your cow’s drinking water to a certified laboratory on a quarterly basis and maintain a historical record of those analyses. If your water test results suggest that you may need to consult a professional water treatment company to rectify a problem, an appropriate closing message on water treatment methods would be, “Show me the science and the proof of improved cow health and performance before I show you any payment.” (1)

Part 3 will be the final installment in this series. That article will address the important issue of water delivery. That article will detail the results of the Thumb $H_2O$ Project’s measurement of whether the milking cow facilities on operating dairy farms met guidelines insofar as number of waterers, space, location, and cleanliness are concerned.

View complete list of references in the web version at [http://www.msu.edu/user/mdr/](http://www.msu.edu/user/mdr/).
California Mastitis Test and Milk Quality

Michael McFadden
Extension Dairy Educator

Introduction

Mastitis continues to be one of the most costly problems in many dairy farms. Mastitis can manifest itself in either clinical or subclinical form. Clinical mastitis is when milk appears abnormal with the presence of flakes, clots, strings or watery. The mammary gland also may be warm or hard to the touch and may exhibit increased sensitivity. In severe cases, systemic signs may be apparent, such as, fever, cow off feed, and in shock.

Subclinical mastitis occurs when both milk and mammary gland appear normal but Somatic Cell Counts (SCC) are elevated to a level above 200,000 cells/mL. It is estimated that production losses (see Table 1) due to subclinical mastitis cost the U.S. dairy industry $1 billion/yr. Additionally, subclinical mastitis contributes to culling, death losses, and increased risk of antibiotic residues in milk.

<table>
<thead>
<tr>
<th>LS</th>
<th>SCC Range (cells/mL)</th>
<th>Milk loss, ld</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>19,000</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>36,000</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>72,000</td>
<td>1.5</td>
</tr>
<tr>
<td>4</td>
<td>142,000</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>284,000</td>
<td>4.5</td>
</tr>
<tr>
<td>6</td>
<td>566,000</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>1,131,000</td>
<td>7.5</td>
</tr>
<tr>
<td>8</td>
<td>2,263,000</td>
<td>9</td>
</tr>
<tr>
<td>9</td>
<td>4,524,000</td>
<td>&gt;9,999,999 =&gt; 10.5</td>
</tr>
</tbody>
</table>

Somatic cells are basically white blood cells (leukocytes) that migrate to the mammary gland in response to infection in both clinical and subclinical cases. This cell migration to the mammary gland is part of the inflammatory response to bacterial infection in the udder. Cows that do not have mammary infections normally have SCC less than 142,000 cells/mL. The California Mastitis Test (CMT) is a cow-side test that allows dairy producers to assess the SCC of each quarter of a cow’s mammary gland.

The CMT Procedure

The test is very simple, can be performed at milking time, gives instant results and is economical. It is a four-compartment paddle with one compartment used per quarter (see picture on page 18). One or two squirts of milk per quarter are collected in each paddle compartment after foremilk is removed. The paddle is tilted to allow most of the milk to run out leaving about 1 to 2 teaspoons (5 to 10 mL) in each compartment. CMT reagent is added to each compartment in volume equal to the retained milk. The milk reagent mixture is swirled in a circular motion with presence of gel or slime being recorded for each quarter. It is the CMT reagent reacting with the DNA of the leukocytes that produces the measurable response in the paddle. Reaction score results are shown in Table 2 on page 18.

Identifying quarters with higher CMT scores increase the probability of getting a positive culture. Quarters with a CMT of “3” are three times more likely to yield a positive culture than a CMT of 1. Conversely, CMT tests that result in “trace” (200,000 to 400,000 cells/mL) are quarters that are likely to be infected, but may be difficult to detect. Thus, the accuracy of CMT or somatic cell counts to predict infection is not perfect.

Studies have suggested that a single CMT or somatic cell count may only detect 60 to 80% of infected quarters. Multiple tests increase the sensitivity of detecting infections, and may be most accurate several days after calving. Thus, decisions for treatment or mastitis management programs should be made with a combination of somatic cell testing, cultures, and cow and herd history.

Potential Uses for CMT

1. Immediate determination of potential infection status of purchased lactating cows. Because the sensitivity of the CMT is not 100%, multiple screenings are suggested.
2. Testing fresh cows on the fourth day of lactation is 80% accurate for predicting infection status. Thus, fresh-cow CMT scores, in con-
junction with CMT scores prior to dry off, may help to evaluate the effectiveness of dry cow therapy and the rate of new infections during the dry cow period. Quarters from fresh cows with high CMT can be selected for milk culture. Depending on bacteriology results and cow history, these animals should be treated or segregated.

3 CMT also could be used to evaluate the success or failure of mastitis treatment during lactation. A negative CMT score at 3 weeks post-treatment with subsequent confirmatory negative tests would suggest that treatment was successful. However, continued monitoring, especially for relapsed clinical cases, should be done.

4 Dry cow CMT scores also can be useful in the administration of dry cow treatments on a selective basis. However, new infection rates during the dry period, and clinical mastitis rates in early lactation, should be monitored carefully if selective dry cow therapy is practiced. In addition, selecting infected cows for therapy with CMT is not foolproof; some infected cows may have low CMT scores, and likewise some non-infected cows may have high CMT scores.

Table 2: California Mastitis Test scores: correlation of CMT score with somatic cell count

<table>
<thead>
<tr>
<th>CMT Score</th>
<th>Somatic Cell Range</th>
<th>Gelling</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>0 to 200,000</td>
<td>None</td>
</tr>
<tr>
<td>Trace</td>
<td>200,000 to 400,000</td>
<td>Very Mild</td>
</tr>
<tr>
<td>1</td>
<td>400,000 to 1,200,000</td>
<td>Mild</td>
</tr>
<tr>
<td>2</td>
<td>1,200,000 to 5,000,000</td>
<td>Moderate</td>
</tr>
<tr>
<td>3</td>
<td>Over 5,000,000</td>
<td>Heavy, almost solidifies</td>
</tr>
</tbody>
</table>

In summary, if the limitations are considered, CMT testing has potential for use in dairy farms. It is a quick, economical method of screening cows, and particularly quarters with elevated SCC, especially over 400,000 cells/mL. This information can be part of a program to determine infection status of mammary glands on a quarterly basis. Implementing CMT testing as a standard operating procedure on your farm may help fine-tune a mastitis therapy program, reduce the risk of antibiotic residues in milk, and increase both quality and quantity of milk produced.

Samples from four quarters on a paddle. One quarter showed CMT-positive and thus needs additional evaluation.

View complete list of references in the web version at http://www.msu.edu/user/mdr/.
MSU Dairy Students Blessed with over $80,000 in Scholarship Opportunities

Miriam Weber Nielsen  
Dept. of Animal Science

Industry & University

The Michigan Dairy Memorial and Scholarship Foundation retains the lead as the largest scholarship program in the College of Agriculture and Natural Resources. In the last decade, the endowment has grown by more than 50% to a principal account of nearly $850,000 and increased by over 40% to 176, the number of individuals recognized as Honorees of the Foundation. Individuals and organizations in the Michigan dairy industry have been the primary contributors to this growth and the increased amount of scholarship funds available to dairy students.

New Honorees of the Foundation this year, recognized through a minimum $1,000 contribution to the Foundation, include Keith Brown, Jack Dendel, John Pell, Marvin Pell, Mike Schwab and Erwin and Loretta Weber. The Foundation awarded over $80,000 in scholarships again this year. Scholarships are awarded on the basis of academics, extracurricular involvement, and interest in a career in the dairy industry.

Glenn and Anne Lake Scholarship
The Glenn and Anne Lake Scholarship pays all tuition and fees for one academic year. This year’s recipient is Karmen Jackson, a senior pursuing a bachelor’s degree in Animal Science. Karmen is the daughter of Gale and Lisa Jackson of Caro and remains active on her family’s farm. She plans to work in dairy and production agriculture, and having a strong interest in environmental concerns, wishes to participate in the industry’s regulatory development. Karmen is involved in dairy research at MSU’s College of Veterinary Medicine, and is working on her certification for Comprehensive Nutrient Management Planning (CNMP) preparation.

Russel Erickson Scholarship
The Russel Erickson Scholarship of $5,000 is awarded to Joseph Ankley. Joseph is a senior from Imlay City, and is dual-majoring in Animal Science and Agriculture Education. He is the son of William and Virginia Ankley, and has an interest in the future diversification of the family farm. He has been active in MSU collegiate FFA, and has been serving as the Student Senate Representative. He is developing a future career path that will combine his desires to teach secondary-level agriculture, and to establish a creamery on the family farm.

Donald and Valera Murray Scholarship
The Donald and Valera Murray Scholarship of $4,000 is awarded to Olivia DeVooght. Olivia is the daughter of Bill and Mary DeVooght of Marquette. Olivia has a double major in Animal Science and Marketing. She has been active in the MSU Dairy Club. Olivia has extensive experience in the dairy industry, including research in health and nutrition, merchandising and sales, farm management, and data management.

Harold and Lillian Gremel Scholarship ($3,500)
Henry Reinart, son of Christopher Reinart D.V.M. in Hopkins, MI, is the recipient of the Harold and Lillian Gremel Scholarship. He is a first year student in the MSU College of Veterinary Medicine. Henry was President of the MSU-CANR Student Senate, an FFA State Officer, Vice President of Leadership in Environmental and Agricultural Fields (LEAF), and a Representative to the ASMSU Academic Assembly. Following graduation, he plans to practice production medicine in his hometown.

Jack and Betty Barnes International Michigan Dairy Memorial Endowed Scholarship ($1,000)
The Barnes Scholarship is provided through an endowment from Jack and Betty Barnes and is given annually to a student interested in a dairy industry career who is participating in an international experience to enhance his or her education. This year’s recipient was Karmen Jackson.

Michigan Dairy Memorial Scholarships ($1,000)
The following students received Michigan Dairy Memorial Scholarships ($3,500): Krista Beeker from Constantine, majoring in Animal Science/Environmental Studies; Melissa Brower, Jamestown, Animal Science; Lauren Bush, Swartz Creek, Animal Science; Stacey Choate, Cement City, Animal Science; Melissa Erdman, Minden City, Production Animal Scholars; Cally Hass, Cassopolis, Animal Science/Agribusiness Management; Jillian Holdwick, Harbor Beach, Animal
MSU Collegiate and Ag Tech Dairy Judging Teams Have Another Successful Year

Joe Domecq
Dept. of Animal Science

The Michigan State University Collegiate and Ag Tech Dairy Judging Teams and over 25 Michigan 4-Hers interested in being member teams that represent Michigan in national contests, spent many summer and fall weekends visiting farms and judging cows in preparation for the 2010 judging season. The teams visited dairy farms in Michigan and across the Midwest.

Scholarships...
Continued from Page 19

Science; Tera Koebel, Three Oaks, Agribusiness Management; Jessica Makowski, Macomb, Animal Science; Kevin Messing, Bad Axe, Biosystems Engineering; Elizabeth Motz, St. Johns, Animal Science/Agribusiness Management; Lynnae Slavik, Ashley, Animal Science; and Eric Sneller, Sebewaing, Animal Science.

Michigan Dairy Memorial Freshman Scholarships ($1,500)
Five Freshman Scholarships were awarded to Leah Cordona of Chicago with a major in Food Science; Emily DeVooght, Marquette, Animal Science; Katelyn Horning, Manchester, Animal Science; Ned Lindsey, Tekonsha, Dairy Management; and Kaitlyn Eisenga, Marion, Dairy Management.

Michigan Dairy Memorial Ag Tech Scholarships ($2,000)
The following students received Michigan Dairy Memorial Ag Tech Scholarships ($2,000): Dale Dick of McBain with a major in Dairy Management; Jamie Atherton, Gaines, Dairy Tech; Deidre Bowen, Cass City, Dairy Management; Ashley Blight, Bancroft, Dairy Management; and Katie Szymanski, Snover, Agriculture Industries.

Howard Cowles Dairy Scholarships
The Howard Cowles Dairy Scholarships are given annually to students in Animal Science who have attained junior status and demonstrated a strong interest in dairy. Academic achievement and participation in extracurricular dairy activities such as the MSU Dairy Club, Dairy Challenge, Dairy Associates Program or MSU Dairy Judging are given strong consideration. The scholarships are provided by revenue from a gift from the estate of Howard E. Cowles, who was a long-time employee of Sealtest Dairy. This year’s recipients of $1,200 scholarships were Katherine Krepps, a senior in Agriscience; and Jessica Makowski, a senior in Animal Science from Macomb.

For information on making contributions to honor members of the dairy industry or to support student scholarships, please contact College of Agriculture and Natural Resources External Relations at (517) 355-0284. To learn more about the Michigan Dairy Memorial and Scholarship Foundation, contact Dr. Miriam Weber Nielsen in the Department of Animal Science (517-432-5443; msw@msu.edu).
Brown Swiss and 10th overall. Hayleigh was 1st in Ayrshires and Guernseys, 3rd in Holsteins and Jerseys, 3rd in reasons and 2nd overall. The Collegiate Team placed 9th in Brown Swiss and Guernseys, 10th in Holsteins and 11th overall.

In early October, the Collegiate, Ag Tech, and 4-H Teams traveled to Madison, WI for the national contests at World Dairy Expo. Michigan 4-H Team members included J.W. Hart (North Adams), Matt Mann (Hillsdale), Sarah Michalek (Deckerville), and Levi Westendorp (Nashville). The Michigan 4-H Team had an outstanding day placing 2nd overall for the second year in a row. The team was 1st in Holsteins, 3rd in Ayrshires, 7th in Jerseys, and 8th in Guernseys. They were also 2nd in oral reasons. By placing 2nd in the contest, this team earned an invitation to participate in the International Livestock Judging Tour in Europe. This is the fourth time in six years that Michigan 4-H has earned this opportunity. Individually, Sarah was 9th in Holsteins, 11th in reasons and 24th overall. J.W. was 6th in Ayrshires, 5th in Jerseys and oral reasons, and 11th overall. Matt placed 1st in Ayrshires, 3rd in Holsteins, 11th in Guernseys, 7th in reasons and 6th overall.

The Collegiate Team placed 7th in Red and Whites, 8th in Ayrshires, 9th in Brown Swiss, 11th in Holsteins, and 11th overall. Lynnae was 2nd in Brown Swiss, 7th in Ayrshires, 10th in Red and Whites, and 11th overall.

The Ag Tech Team placed 1st in Milking Shorthorns, 3rd in Red and Whites, 4th in Jerseys, 5th in Brown Swiss, and 6th overall. Cristine was 3rd in Ayrshires. John was 4th in Milking Shorthorns. Dale was 2nd in Brown Swiss, 3rd in Milking Shorthorns, 8th in Red and Whites, and 8th overall.

The final contest of the year was held at the North American International Livestock Exposition in Louisville, KY in November. The Collegiate Team placed 4th in Holsteins, 5th in Jerseys, 6th in Brown Swiss, 7th in Guernseys, 8th in oral reasons, and 5th overall. Sara was 8th in Brown Swiss. Lynnae was 3rd in Jerseys, 8th in Guernseys, 4th in reasons, and 7th overall.

The Ag Tech Team had an outstanding day. They placed 1st in Ayrshires and Brown Swiss, 4th in Jerseys, 6th in Guernseys, and 4th in reasons and overall. Individually, Cristine was 3rd in Holsteins. John was 1st in Brown Swiss, 3rd in Guernseys and Jerseys, 9th in Ayrshires, 8th in reasons, and 3rd overall. Dale was 1st in Ayrshires and Guernseys, 4th in Brown Swiss, 3rd in reasons and 5th overall.

Michigan 4-H was represented in this contest by Lauren Bush (Swartz Creek), Casei Hart (Grass Lake), Katelyn Horning (Manchester), and Marshall Wixom (Bloomingdale). This team placed 6th in Jerseys, 10th in Brown Swiss, 11th in Guernseys, 8th in reasons and 10th overall. Lauren was 2nd in Jerseys.

The Michigan 4-H teams are selected from the top 25 individuals at the state judging contest held during Michigan Dairy Expo in July. These individuals are invited to participate in several workouts during August, and the teams for each contest are selected by the first of September. All 4-H youth are invited and encouraged to participate in the contest at Michigan Dairy Expo and try-out for one of the national teams. The Collegiate and Ag Tech team members are selected from students attending Michigan State University who have completed a judging course and have been part of the judging program during their education at MSU.


The MSU Dairy Judging Program would like to extend appreciation to all of the individuals, farms, and agricultural businesses that support the program by providing cattle, expertise, and financial support. Special thanks to Sarah Black, Jess Jakubik, Amanda Sollman, Heather and Jessica Fry, and Emily Butcher who coached and traveled with the teams to various contests and workouts this fall. The MSU Dairy Judging Program is coordinated by Dr. Joe Domecq.
Enhancing Fertility...
Continued from Page 3

Rolling Acres Farm, Allegan, MI

Merle Coffey, owner of Rolling Acres Farm, Allegan, MI utilizes G6G (see Calendar on page 23, and Figure 3 on page 2) to increase the reproductive performance of his 800-cow herd. Only cows ready for 1st AI receive the G6G program. Average days to first service for his herd is now 100 days. After first AI, if cows are detected in estrus, they are inseminated using the AM/PM rule. If cows reach pregnancy diagnosis (Biopryn at 32 d after AI) and are diagnosed as not pregnant, they are re-synchronized with Ovsynch. Monthly conception rates are displayed in Figures 4 and 5).

Figure 4: Monthly 1st service conception rates using G6G at Rolling Acres Farm, Merle and Arlyn Coffey from October 2008 to December 2010. All cows receive G6G for 1st service.

Figure 5: Monthly conception rates for cows receiving 2nd service or greater following detection of estrus or resynchronized using Ovsynch following a not-pregnant diagnosis at Rolling Acres Farm, Merle and Arlyn Coffey from October 2008 to December 2010.

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These Producers Get Cows Pregnant

Congratulations to Henk Knevelbaard of Fremont, MI for being awarded the 2010 Dairy Cattle Reproductive Conference Platinum Level Award. Henk and his crew (pictured) milk 1,100 cows most of which are Holstein, although, a portion of the herd is being crossed to Swedish Red and Montbéliard sires. Henk utilizes both estrus detection and timed-AI to achieve top reproductive performance. Approximately 75% of cows that are eligible for AI are inseminated following a detected estrus and about 25% are timed-inseminated following a Pre-synch-14/Ovsynch program.

Post These Calendars for Several Timed-AI Protocols

**Pre-synch-11 for 1st AI.**

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**G6G for 1st AI (Also for Re-Sych following diagnosis of not-pregnant).**

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**Double Ovsynch for 1st AI.**

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**Abbreviated Pre-synch-11 AI following diagnosis of not-pregnant.**

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**GGPG for AI following diagnosis of not-pregnant (used in the absence of CL at not-pregnant diagnosis).**

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* Our data suggest that cows greater than first parity (2+parity) have reduced corpus luteum (CL) regression following one injection of PGF. Another injection of PGF 24 h after solve this problem.

View complete list of references in the web version at [http://www.msu.edu/user/mdr/](http://www.msu.edu/user/mdr/).
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