Economic Implications of Culling: Part 1

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Culling can be both the easiest and the hardest decision to make on the dairy farm. Many culling decisions can be very straightforward—this cow must go! Other decisions are not so easy and many times you are never quite sure you made the right decision. In the next two issues of the Michigan Dairy Review I want to address the economic implications of culling. I have no illusion that these articles suddenly will make every culling decision easy and straightforward. However, it is my hope that this information can make you better prepared as you approach the more difficult culling decisions.

When considering the economics of culling, four important topics should be discussed:

1. cost of replacements;
2. capital requirements that culling imposes upon the farm business;
3. “optimal” culling rate; and,
4. the proper approach to individual cow culling decisions.

In this issue I shall consider the cost of replacements and the capital requirements culling imposes on your farm business. In the next issue I shall discuss an optimal culling rate and how to handle individual cow culling decisions.

Cost of Replacements

In many respects the cost of replacements is a distinct and separate issue from culling economics. However, the cost of replacements is an important factor affecting all dairy farms. In Michigan, the bulk of dairy producers raise most, if not all, of their replacement heifers. Therefore, it is important to realize that the heifer enterprise consumes a large share of the economic resources on typical Michigan dairy farms (Figure 1).

Given the state of the art of our accounting and inventory systems, accurate estimates for the true cost of raising replacement heifers are unavailable on most dairy farms. Even though the exact cost of raising replacements is not known on the majority of farms, we do know the cost of high quality replacements is higher than most producers believe. Most well-managed Michigan dairy farms can raise replacements from birth to first calving for $1,200 - $1,600 per head. The cost for most producers is much closer to the high end of the range rather than the low end. Everyone is keenly aware that prices for purchased replacement heifers have been extremely high over the past 1-2 years. Many replacement heifers have sold for $2,000 or more. Fortunately, there is some indication recently that prices have been moderating by $300 or more per head. However, it is uncertain how long this moderating...
trend will hold. I would expect that replacement heifer prices will tend to mirror milk prices. When milk prices rally it is quite likely that heifer prices will trend upward once again.

**Capital Requirements**

We know that the number of replacements needed on an annual basis is high. For example, 2002 Michigan DHIA data indicated that the average cull rate on Michigan DHIA herds was 37%. Given the need to replace over one-third of the milking herd on an annual basis, the culling question quickly turns into this question: How much capital is required to maintain “steady state” operation of the typical dairy herd? In other words, how much money must be spent for the typical dairy herd to maintain the status quo number of animals in the milking herd.

The *Michigan Dairy Farm Business Analysis Summary* (2, 3) has been prepared annually for the last 7 years (1995-2001). In that summary the financial data from approximately 140 Michigan dairy farms are summarized annually. According to these data the average dairy farm milked a total of 184 cows. Michigan DHIA data reveal that the average cull rate on Michigan DHIA dairy farms is 37% and about 17% of culled animals are culled because they “died” (1). Given these numbers we can calculate that a typical Michigan dairy farm consisting of 184 total cows would annually cull 68 cows per year from the herd. Of these 68 culled cows, 12 would have been culled because of death. Therefore, 56 cows would be culled and sold at salvage value. The 56 cows sold at salvage value would generate approximately $27,216 (cull cows sold at 1,350 lb for $0.36/lb) in recaptured capital. If we assume that it costs $1,600 to either raise a replacement heifer, or purchase that heifer, it is going to require somewhere around $108,800 in capital to furnish the required 68 replacements.

Therefore, the net cost of annual replacement becomes $81,584 for a dairy herd that milked 184 cows annually. Another way to look at this problem is that each cow in this typical herd must contribute $443/year in income just to provide the capital needed to maintain the “steady state” operation of the herd.

<table>
<thead>
<tr>
<th>Lactation</th>
<th>Milk (current lactation)</th>
<th>Milk (cumulative)</th>
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<tbody>
<tr>
<td>1st</td>
<td>18,269 lb</td>
<td>18,269 lb</td>
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<tr>
<td>2nd</td>
<td>18,534 lb</td>
<td>36,803 lb</td>
</tr>
<tr>
<td>3rd</td>
<td>18,773 lb</td>
<td>55,575 lb</td>
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*Michigan Dairy Farm Business Analysis Summary* data over the past 7 years also indicate that the average total accrual adjusted cost per cow is $2,828. Hence, the $443 burden each cow must bear amounts to nearly 16% of the total per cow cost of operating the typical Michigan dairy farm. As a result, replacement costs on Michigan dairy farms represent a very significant cost. In terms of percentage of total cost, it ranks a very close third behind purchased feed and hired labor (Figure 2).

When we look at the replacement heifers entering our typical herd, they are required, when adjusted for anticipated
death loss, to cover $1,197 worth of costs (either rearing costs or cost of purchase) before they become profitable. *Michigan Dairy Farm Business Analysis Summary* (2-3) data indicate that the average profit margin per cwt of milk produced over the last 7 years was $3.60. Given this profit margin and the fact that the typical dairy herd averaged 20,406 lb of milk sold per cow per year, the average replacement heifer will have to produce approximately 33,240 lb of milk before she pays off her purchase or rearing costs.

You might compare this concept to the concept of “tax freedom day”. Each year around the middle of May we hear news reports that such-and-such a day is “tax freedom day”. In other words, this day represents the day when the average American worker has generated enough gross income since January 1st to pay all their taxes for the calendar year. Supposedly after “tax freedom day” the rest of the year’s wages go directly into the worker’s pocket instead of to Uncle Sam. We can view the heifer example as a parallel. To maintain herd size the heifer must pay for her rearing or purchase costs before she returns the dairy producer any profit. Therefore, her “tax free day” is not reached until she produces enough milk income to pay for those costs. Importantly, this analysis does not consider the time value of money. In other words, the money you have invested in the heifer, especially if she is home-raised, could have earned a return in some alternative investment (e.g., stocks, certificates of deposit, etc.). If we adjust the typical heifer’s production for her age, it easily can be seen that the heifer must produce two complete lactations for you to recoup your invested capital in her (Table 1).

In our next issue I shall address optimal culling rate and how to make culling decisions on individual cows in the herd.

**References**


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**Environmental Management**

**Environmental Stewardship: Animal Lot Runoff Management**

Dann Bolinger and Natalie Rector

*Extension Dairy, Ag. and Natural Resources Agents*

**Keeping dairy cattle outdoors on either earthen or concrete lots is a common practice in Michigan. In recent years, the use of outdoor lots has come under scrutiny. Why the concern? Nutrients from manure and (or) feeds can be in runoff. If these nutrients reach ground or surface waters there is an environmental concern.**

In the 1960s and earlier, recommendations for new dairy facilities included large uncovered concrete lots. The concept emphasized the benefits of exercise, exposure to sunlight, and air quality on animal health and performance. Today, many animal facilities from that era and even newer facilities still utilize outdoor lots. The concept of outdoor lots and their management has remained unchanged over the years, but our understanding of potential negative environmental impacts from outdoor lot runoff has changed. The ecological and regulatory consequences of manure and feed nutrients along with the concern for pathogens entering surface and ground waters can be significant. As a result of recent emphasis on reducing pollution from agricultural sources, outdoor animal lots are receiving new attention. Dairy and livestock producers need to understand the environmental expectations placed on outdoor animal lots as they relate to facility design and management.

The Michigan Right to Farm Generally Accepted Agricultural and Management Practices (GAAMP) guidelines for Manure Management and Utilization indicate a need for producers to assess outdoor animal lots. If runoff from a lot has an adverse impact on surface or ground water or leaves the property of the farmer, then runoff control is required for nuisance protection under the GAAMP. It is unacceptable for outdoor lot runoff to reach a neighbor’s land, roadside ditch, stream, lake, or wetland. The ponding of runoff in a low spot is also of concern due to the potential leaching of nutrients and pathogens to groundwater.

**Is It a Pasture or Outdoor Lot?**

It is important to distinguish between a pasture and an outdoor lot. The *Answers to Frequently Asked Questions*
Four essential characteristics of a true pasture are:

1) the land is used primarily for production of forages upon which livestock graze;
2) the predominance of vegetation is a desirable forage species;
3) the grazed forage is generally the primary feed source for the livestock. This includes hay harvested from pastures during spring flush and later fed in movable feeders in the pasture; and,
4) stocking densities and management systems ensure that desirable forage species are present with an intensity of stand sufficient to slow the movement of runoff water and control soil erosion and movement of manure nutrients from the pasture land.

Any outdoor animal area not meeting all four of these pasture characteristics would be considered a “lot” and thereby needs management to reduce the risk of negative impact on surface or ground waters.

Commonly overlooked outdoor lots include those areas that may have once been a pasture but no longer maintain the characteristics of a true pasture, yet are still referred to as a pasture. High use areas within a true pasture also may be of concern. These areas include traffic lanes, corrals, and areas around waterers and feeders.

Assessing your facilities for potential areas of concern is the first step in taking action to improve environmental stewardship associated with outdoor lots. A simple and effective method of identifying these concerns is to wait for a rainy day and follow the water. During a rain event, investigate if the water made contact with outdoor lot surfaces containing manure and feedstuffs and assess where the runoff travels. The direct movement of lot runoff to surface water either across the surface or through basins and tiles is a problem that should be addressed promptly. There are, however, less obvious concerns. For instance, the frequent ponding of runoff in a low spot or the accumulation of manure solids in an adjacent area may be an equal threat to ground water because of the concentration of nutrients in a single location and its eventual leaching downward. Be sure to observe if the runoff travels to areas near well casings, tile inlets, drainage ditches, and other less obvious direct links to ground and surface water.

There are numerous options to reduce or eliminate the risk of lot runoff. What appears to be the best option for one farm, may lead to economic hardship or adverse management implications to the next farm. Solutions should be tailored to each farm’s location, existing facilities, financial position, and management style.

**Ask the Following Questions**

Reducing or completely eliminating runoff will hold opportunities to improve a situation in a profitable manner. Think about the following questions regarding the lot being addressed.

1. **Is the lot needed?** Sometimes the use of an outdoor lot is more of a tradition or a perceived need than an actual necessity for profitable animal management.
2. **Can the lot be reduced in size?** Eliminating the lot may not be an option, but can it be made smaller. Oftentimes, lots are much larger than necessary for maintaining profitable animal performance and well-being. For example, many older facilities have 50 to 100 feet between the barn and a fenceline feed manger. The Midwest Plan Service Publication (MWPS-7) indicates a minimum space required for a mature cow feed alley of only 12 to 14 feet. In this instance, there is opportunity to reduce significantly the lot area exposed to runoff potential.
3. **Can it be covered?** Rarely is this a viable option; however, it is worth considering whether or not a roof could be constructed over the lot. Economics and practical implications such as ventilation usually reduce the feasibility of implementing this alternative.
4. **Is clean water unnecessarily contacting the lot surface?** Precipitation landing on barn roofs, driveways, and areas adjacent to animal lots is normally “clean” water. By diverting this water before it contacts the animal lot, it becomes unnecessary to treat it. **Gutters:** Properly sized, installed, and maintained industrial roof gutters can redirect clean roof water to an appropriate alternative location. With properly installed industrial guttering, the common concern of ice slide damage can be avoided. **Diversions:** It is helpful to ensure that water from adjacent driveways and other clean areas is not passing through the animal lot. Grading and diverting this water away from areas with manure can prevent the need for treating this water.
5. **Can lot management reduce the concentration of nutrients and pathogens in the runoff?** Keep lots, whether concrete or earthen, scraped so there is less manure available for transport via runoff. A practical implication would be to scrape the lot frequently, but especially in advance of forecasted precipitation events.
6. **For earthen lots and high use areas of pastures, can conservation practices be implemented to reduce environmental risk?** For instance, can stocking densities be reduced with either fewer animals or more area such that it is a true pasture and not a lot? Can rotational management of paddocks be utilized to maintain adequate vegetation? Can high use areas such as watering and feeding areas be relocated frequently and the previous site revegetated?
7. **Can the integrity of the lot surface be improved and demonstrated to minimize risk to ground water?** Since soil and subsurface characteristics of earthen lots influence risk to ground water, can this risk be managed? Is an engineered, compacted clay earthen lot appropriate? Are cracks, holes, or other indications of poor integrity evident in concrete or paved lot surfaces?

If lot runoff cannot be entirely avoided, then containing...
and treating it is the next option to be considered when addressing concerns. Containment and treatment options include storage and land application as well as settling basins in conjunction with filtration areas or constructed wetlands.

**Investigate Your Options**

The most simplistic containment option would be to simply capture the runoff in an existing manure storage. The disadvantage to this alternative is that it decreases the storage volume for manure and increases the amount of water that will need to be hauled. To illustrate the magnitude of runoff volume, consider that Michigan receives approximately 34 inches of rain annually. That equates to about 21 gallons of water per square foot per year. A relatively small lot of only 50 ft. by 50 ft. would have nearly 53,000 gallons of precipitation hitting its surface each year. That’s a lot of water to handle in storage and apply to fields!

Constructing a separate, designed storage exclusively for runoff is another option. It does not eliminate the need to handle the volume of runoff for field application, but it will not impact the capacity of other manure storages. This may be an appealing option if irrigation can be used for field application. Runoff is typically very dilute in solids and nutrients and may work well in an irrigation system.

**Summary**

Implementation and management of practical solutions can reduce much of the concern related to runoff from outdoor lots. It is the responsibility of each dairy or livestock producer to seek input for their specific situation from appropriate professionals such as the USDA Natural Resources Conservation Service (NRCS), Soil and Water Conservation Districts, MSU Extension, or private consultants and engineers. Pursuing a balance between economic feasibility, practical feasibility, and the long-term goals of the farm will lead to the most appropriate solution. Remember that the bottom line is to demonstrate that a discharge of nutrients or pathogens to surface or ground water or to another property is not occurring.

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**Disposal of Dead Animal Bodies**

**Kevin Kirk**  
Michigan Dept. of Agriculture

This Act regulates the proper disposal of dead animals and provides regulations for poultry and livestock composting. The regulations of the Act define the procedures by which dead animals are disposed. The Michigan Department of Agriculture (MDA) shall implement the rules and enforce this Act.

All dead animals shall be disposed of within 24 hours after death by any of the following methods:

1. **Burial** not less than 2 feet below the natural surface of the ground.
   - The number of individual graves per acre shall not be more than 100 and the total combined animal weight shall not be more than 5 tons per acre.
   - A grave shall not be located within 200 feet of any existing groundwater well that is used to supply potable drinking water.

2. **Procuring the services of a licensed dead animal dealer.**

3. **Procuring the services of a licensed rendering plant.**

4. **Procuring the services of a licensed animal food manufacturing plant.**

5. **Hauling to a licensed landfill.**

6. **Processing at a composting structure.**
   - The composting structure shall be built of a concrete floor, consist of two or more bins, each constructed with not less than three side walls built to at least the height of the highest point of any composting material. There must be a roof over the composting area.
   - Carcasses and bulking agent shall be added in layers so that the carbon-to-nitrogen ratio in the primary compost pile is between 15 to 1 and 35 to 1, seeking the optimal ratio of 25 parts carbon to 1 part nitrogen.
   - The temperature of the pile is monitored and recorded twice weekly. The compost pile temperature shall reach 130 degrees Fahrenheit on successive readings weekly.

   - The finished compost may be applied directly to soils following generally accepted agricultural and management practices.

   - Please note additional requirements are described in the R.287.656 of Regulations for Bodies of Dead Animals.

**Summary**

The above information specifies key points for both burial and livestock composting. Producers should acquire a copy of the law and regulations for the entire requirements.

Copies of the Act and regulations may be obtained from the Animal Industry Division of the Michigan Department of Agriculture by calling (517) 373-1077.
Until recently, the milk price forecast called for a rebound of milk prices, although not likely before Fall 2003. However, these forecasts counted on the low milk prices putting the brakes on milk production. That has not happened. As I write this at the end of March, it appears increasingly unlikely that any significant milk price recovery will occur this year. When the down turn in production occurs, and it will, it may unfortunately be driven by large numbers of dairy farm exits.

Why is the outlook so pessimistic? Several reasons: milk production shows few signs of letting up, flat consumption, and large product surpluses. As producers are well aware, milk prices have been low since last summer. In recent months they have been abysmal with Class III (milk for cheese) price below the support price of $9.80/cwt (3.5% butterfat milk) in 5 of the previous 8 months. Despite these prices, US milk production has continued to increase. 2002 US milk production increased 2.7 percent over 2001. The growth has continued into 2003 thus far with January production up 1.8 percent over a year earlier and February up 1.7 percent. Michigan increased milk production 1.3 percent in 2002 over 2001. The large growth in milk production, consistent with recent trends, was in Western states. Idaho increased 5.1 percent; New Mexico 13.6 percent; Arizona 11.6 percent; and, Kansas 24.8 percent. California increased milk production 5 percent for 2002 which amounted to 28 percent of Michigan’s 2002 milk production and more than the total production in 28 individual states.

When will production react negatively to prices? That is the key question for a significant milk price recovery. Part of the conventional wisdom is that the expansions in the West are finished and the growth from these expansions should slow. However, total US cow numbers continue to hold steady (Figure 1). As of February, cow numbers in the 20 major dairy states totaled 7.81 million. This value was near the most recent high value for 2000. Prior to the upturn in cow numbers in 1999, the long-run trend had been a steady decline in milk cow numbers. With the average cow increasing productivity, the only way to cut production is to get rid of cows.

One factor contributing to the lack of farm exits by assisting with cash flow is the Milk Income Loss Contract (MILC) deficiency payment that averaged $1.20/cwt for 2002 and was announced at $1.75/cwt for March of 2003. Figure 2 displays the Michigan milk-to-feed price ratio for 2003-03 with and without the MILC payment in a given month. With the fiscal year for payments starting in October 2002, many large or mid-sized farms may have reached the production payment limit of 2.4 million pounds. As this occurs, the farms will move from the higher line, indicating more potential profits (or smaller losses as the case may be) to the lower line which represents a bleaker financial picture. Farms below the 2.4 million pound payment limit can expect to continue to receive payments of $1.40 or more for 2003.
Nutrition Management

What Are Cows Really Eating?

Herb Bucholtz
Dept. of Animal Science

Dairy cattle rations are balanced to meet precise nutrient requirements by formulating particular ingredients in exact amounts. The goal for balancing and formulating rations to a higher level of precision is the anticipation that cow performance will meet or exceed expectations without experiencing digestive or metabolic problems. That’s a great goal, but why doesn’t every ration that is formulated and fed produce the expected performance? That is a good question, and there are a whole host of possible answers. This article will look at a few possibilities that may be overlooked when a feeding program just doesn’t seem to be working, when milk production is suboptimal and there is a high incidence of digestive and metabolic problems.

Ration Sorting by Cows

Observe the eating behavior of cows after they are fed a total mixed ration (TMR). Do they eat in a manner that every bite contains the same ingredients? Or do the cows nose the TMR around in an attempt to sort the ration and then consume the ingredients they want to eat? Cows have the ability to sort out certain ingredients in a TMR at the feed bunk and either consume certain ingredients or refuse to eat them. Sorting of corncobs, stones and spoiled feed is obvious and easy to observe. Most people would give the cow credit for this type of sorting. But what else in the TMR, given the opportunity, do cows decide they might not want to eat?

Ration sorting might help explain why milk production may go up and down and give reasons why digestive and metabolic health problems occur. One of the concepts for feeding a TMR is that cows supposedly will consume correct proportions of all ingredients contained in the TMR with each bite they eat. But, if the cows sort the TMR and only consume the ingredients they want, this can destroy one of the founding principal advantages of the TMR concept. And this might help explain milk production and health related problems.

Do cows really sort certain ingredients in an attempt not to consume them? Researchers in Michigan (2) and Wisconsin (1,3) found that lactating cows do sort against consuming large particles contained in a TMR. As the amount and length of dry hay or forage silage increased in a TMR, greater sorting against consuming the long particles occurred. Sorting by individual cows was variable; some cows sorted more than others, which might help explain why some cows within a group experience digestive health problems while others do not.

Field Studies Conducted

Field studies on well managed commercial dairy farms in Michigan (5) and Wisconsin (4) investigated the ability of cows to sort the feed bunk’s TMR from the time of feeding until the next feeding. In both studies the TMR was separated using the Penn State-Particle Separator. Particle size distribution at different intervals post-feeding for the two studies is shown in Tables 1 and 2. The Michigan herd was fed 3 times per day and the TMR contained: haylage, corn silage, high moisture corn, long chopped dry hay, and grain supplement. The Wisconsin herd was fed 1 time per day and the TMR consisted of haylage, corn silage, long chopped dry hay, and grain supplement.

The data in Tables 1 and 2 show that the percent of the particles retained on the “top screen”, the long particles, increased from the time the TMRs were fed. This became particularly noticeable after 8 hours for the Michigan herd and after 16 and 23.5 hours for the Wisconsin herd where the majority of the feed bunk’s ration not eaten was the

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<tr>
<th>Table 1. Michigan herd: Particles retained from feeding time 0 to 8 hours post-feeding (5).</th>
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<tbody>
<tr>
<td>Hours: post-feeding</td>
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<tr>
<td>Top screen (long particles), % of DM</td>
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<tr>
<td>Middle screen, % of DM</td>
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<tr>
<td>Bottom pan (fine particles), % of DM</td>
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<tr>
<th>Table 2. Wisconsin herd: Particles retained from feeding time 0 to 23.5 hours post-feeding (4).</th>
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<tr>
<td>Hours: post-feeding</td>
</tr>
<tr>
<td>Top screen (long particles), % of DM</td>
</tr>
<tr>
<td>Middle screen, % of DM</td>
</tr>
<tr>
<td>Bottom pan (fine particles), % of DM</td>
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long particles contained on the top screen. Visual observation of the feed in the bunk and of the samples after separation showed that the material contained on the top screen after 8 hours for the Michigan herd and after 16 or more hours for the Wisconsin herd consisted mainly of long roughage material. These two field studies showed that cows can and will sort long particles out of a TMR and that they select against consuming long particles. The data also showed that the cows consumed more of the fine particles because the percent contained on the bottom pan decreased over time. Both of these were well-managed herds but were experiencing suboptimum milk production and greater than expected digestive and metabolic problems.

The use on these farms of the Penn State-Particle Separator as a management tool to collect particle size data at different times after the TMR was fed helped these dairy producers and their advisors determine that the cows were indeed sorting the TMR. The data showed that the cows were not consuming sufficient amounts of long fiber but were readily consuming the fine feed particles. This helped explain the higher than expected digestive and metabolic health problems even when the rations were formulated to contain sufficient fiber. For whatever reason, the cows made the unwise decision to sort out and consume less long particles preferring instead to consume the fine feed particles. The Wisconsin research (3) reported large variation in sorting among individual cows within a group, which may explain why all cows in a group do not experience digestive and metabolic health problems but only certain cows.

TMR Sorting Reduced

Both dairy producers made feeding management changes that reduced sorting of the TMR. The changes included, reducing the amount or eliminating chopped dry hay, feeding more haylage, adding molasses or water and increasing the moisture of the haylage to help bind particles in the TMR. The nutrient formulation (protein, energy, fiber, mineral, and vitamin concentrations) of the rations basically remained unchanged. The changes were in feeding management and ingredients used. After the ration sorting was reduced, the herds experienced higher milk production and fewer digestive and metabolic health problems. The important message here is that management decisions can help correct a sorting problem, and that inclusion of perhaps expensive ingredients may not be necessary to correct a nutritional feeding problem.

Would evaluating a herd for sorting be a useful feeding management evaluation tool?

For the two commercial herds’ management and their advisors, the sorting data provided the information to make good management decisions to help control sorting and digestive and metabolic health problems. Evaluating for TMR sorting over time after feeding does take considerable time, 24 hours for the Wisconsin herd and over 9 hours for the Michigan herd. The time and effort was profitable for those herds. This evaluation tool can be worthwhile to utilize on any farm.

What are some management strategies that might be implemented to help reduce TMR sorting?

This article would not be complete without discussing some factors that may contribute or increase the opportunity for the cows to sort a TMR.

1. Ingredient quality – spoiled, unpalatable feeds may increase sorting.
2. Ingredient or TMR moisture – drier feeds are easier for cows to sort out.
3. Particle length of roughages – longer roughages are easier to sort – whether the roughage is a silage or dry hay.
4. Amount of easily sortable feeds added to the TMR – more pounds of an easily sortable feed added to a TMR might increase sorting.
5. How often the TMR is fed or pushing up feed – more frequent feeding or pushing up may reduce sorting.
6. Addition of water or other liquid ingredients to the TMR – may help bind drier or longer ingredient particle to finer particles making sorting more difficult.

Summary

Evaluating for TMR sorting over time after feeding can be a very useful feeding management tool to implement. The time and effort expended collecting and evaluating the data has the potential to assist in controlling nutritionally related challenges.

References and Additional Reading

Health Management

Split-State Status Proposed For Michigan

In the fall of 2002, the Michigan Department of Agriculture applied to the United States Department of Agriculture (USDA) for recognition of two bovine tuberculosis zones in the state of Michigan. The process of gaining split-state status is moving forward with the publication of the proposed split-state status rule in the Federal Registrar on April 7, 2003.

In brief, USDA is proposing to amend the bovine tuberculosis regulations by establishing two separate zones with different tuberculosis risk classifications in the state of Michigan and raising the designation of one of those zones from Modified Accredited to Modified Accredited Advanced.

This action is being proposed based on determination that Michigan meets the requirements for zone recognition and that one of the zones meets the criteria for designation as Modified Accredited Advanced.

The proposed two zones include:
- Alcona, Alpena, Cheboygan, Crawford, Emmet, Montmorency, Oscoda, Otsego, and Presque Isle Counties and those portions of Iosco and Ogemaw Counties that are north of the southernmost boundary of the Huron National Forest and the Au Sable State Forest; and, the second zone is the remainder of the State.

Direct link to this proposed rule can be found at: www.bovineTB.com and is open for comment to USDA until June 6, 2003.

What Split-State Status Means

Currently the entire state of Michigan is recognized as a Modified Accredited state in the national bovine TB program. With the application for split-state status, it is hoped that parts of Michigan where bovine TB has not been demonstrated can be moved up in status to Modified Accredited Advanced. This improvement in status would reduce the minimum interstate (between states) movement requirements as established by the USDA Uniform Methods and Rule (UMR) for bovine tuberculosis. A comparison of the minimum interstate movement requirements for the two status levels follows.

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<thead>
<tr>
<th>Animal Classification</th>
<th>Modified Accredited</th>
<th>Modified Accredited Advanced</th>
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<tbody>
<tr>
<td>Steers or spayed heifers and heifers moved to approved feedlot</td>
<td>Negative individual tuberculin test within 60 days prior to movement</td>
<td>No test required</td>
</tr>
<tr>
<td>Sexually intact cattle</td>
<td>Whole herd test within the year prior to movement and Individual test within 60 days of movement</td>
<td>Individual test within 60 days of movement</td>
</tr>
<tr>
<td>Cattle moving directly from a bovine TB accredited free herd</td>
<td>No test required</td>
<td>No test required</td>
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<tr>
<td>Cattle moving direct to slaughter</td>
<td>No test required</td>
<td>No test required</td>
</tr>
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It should be recognized that these are minimum requirements established by USDA. Any state may have additional requirements. Therefore, it is imperative that when moving cattle interstate, you should check with the state of destination to find out what the current requirements are for cattle to enter that state.

Avoiding Drug Residues in Meat

Approximately 33% of the total beef production in the U.S. is from marketed dairy cows. In 1990, 1991 and 1993, antibiotic residues were found in 1.7%, 2.2% and 1.5% of marketed dairy cows, respectively (1). In 1990, 56% of consumers surveyed rated antibiotics and hormones in livestock as serious hazards. In addition, red meat is most frequently mentioned as food to be avoided due to safety concerns. From the above discussion it is evident that consumers want a safe, drug-free food supply and that the consumers’ perception that beef is pure and uncontaminated is important in maintaining public confidence in livestock production (2). Prevention of antibiotic residues in meat is the responsibility of all livestock producers, including dairy producers.

Use of antibiotics in dairy farms should be under the supervision of one specific person on the farm. Further, the designated supervisor must have an effective communication system with all other personnel involved in usage of antibiotics. Ineffective communication and misunderstandings are two major causes of mismanagement of both treated animals and antibiotic therapy on livestock farms.
Management Strategies

Consider the following management strategies for your farm.

1. Have a locked and secure drug storage facility.
2. Drugs must be stored according to PMO (Pasteurized Milk Ordinance) guidelines.
3. Keep inventory of all drugs on hand.
4. Keep written records of usage of all drugs in all situations.
5. Identify treated animals properly; i.e., neck chains, leg bands, crayon marks, paint sticks, or electronic devices.
6. Follow meat withdrawal instructions on label or as provided by your veterinarian if product is used off label in accordance with the Animal Medicinal Drug Use Clarification Act (AMDUCA).

Additional considerations for drug residue avoidance include:

1. Use of drugs off label is illegal unless prescribed by a licensed veterinarian and in accordance with AMDUCA.
2. Use of drug doses in excess of label dosage can result in residues after expiration of the withholding times.
3. Alternate routes of drug administration can result in drug residues existing longer than the labeled withholding period.
4. Treatments consisting of combinations of drugs can have longer than anticipated withholding times.
5. Use of drugs in an unapproved species or type of animals; i.e., dairy vs. beef.
6. Very ill animals can take longer then expected to clear drugs from their systems (3).
7. Usage of drugs for treatment of a condition and not approved on the label.

Reading and following label instructions and written treatment records are the cornerstones of an effective livestock drug management program. Deficiencies in these areas can result in illegal drug residues in meat, regulatory penalties, and erosion of consumers confidence in the safety of the livestock-related food supply.

References:

Antibiotics, Are They Still Working?

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“Doctor Averill! I have a few cows that I would like you to take a look at. I have been treating them for mastitis for the last 6 weeks, and each time I think I have licked the problem it comes right back. I have tried everything, do you have a special drug to cure this problem for me?”

This scenario and others like it happen often. Farmers and veterinarians always are looking for that silver bullet, the cure all to end all. The fact is, pharmaceutical companies are not producing new antibiotics fast enough. Between federal regulations becoming more stringent and lack of economic incentive for pharmaceutical companies to develop new drugs, new antibiotics are not likely to enter the market for animal agriculture in the near future.

When antibiotics came onto the market in the 1940s and 1950s people were hopeful that bacterial illnesses would be practically eradicated. Instead, we found that with time bacteria evolved resistance to antibiotics. With this evolution, there has been a lot of finger pointing going on about who is to blame. Some people believe the agricultural community is to blame, especially because of non-therapeutic drug use in the feed and water. Also, over prescribing drugs in human medicine contributes to this problem.

Antimicrobial resistance has become a major public health concern. Human medical doctors have to deal with the issue daily. Veterinary medicine has been fortunate so far, but there may come a day when trying to find an effective antibiotic to treat an animal will be difficult.

Prudent Drug Use Guidelines

The American Association of Bovine Practitioners (AABP), American Veterinary Medical Association (AVMA), and U.S. Food and Drug Association (FDA) have put together prudent drug use guidelines for animal agriculture. Below you will find key points about these guidelines:

1. Farm Management. The use of vaccines, proper housing and nutrition will reduce the incidence of disease and the need for antimicrobials.
2. Case Selection. Determining acute vs. chronic cases is important. Chronic cases are poor candidates for drug therapy as they have been diseased for a long period of time and most likely will not recover. It may be more economically beneficial to just isolate or remove the animal from the herd. Also, a correct diagnosis of the disease is important. Antibiotics are only effective against bacteria, NOT viruses. Having a standard operating procedure (SOP) is beneficial.
3. Antibiotic Selection. Drug therapy should be made with a specific clinical outcome in mind (reduce fever, return mastitic milk to normal appearance, reduce shedding bacteria). Use antibiotics with the narrowest spectrum of activity and approved labeling for the presumed organism whenever possible. Do not mix antimicrobials and only administer extra-
Many dairy farms have Hispanic employees milking the cows. Frequently these employees also are responsible for cleaning protocols that affect milk quality.

We conducted a study on a 2800-cow dairy in western Michigan between June 2001 and June 2002. It was determined that the failure to communicate between English speaking and non-English speaking employees limited the dairy’s ability to achieve high milk quality. These daily failures limited the employees’ abilities to make positive changes in procedures and tasks.

In response to this need, a Hispanic milk quality specialist worked on the dairy for 1 year. This veterinarian had the necessary technical skills, language, and cultural sensitivity needed to make changes on the dairy. Milking classes were designed using a PowerPoint® and hands-on training format. The when, how, and why of daily routines were discussed in twice monthly meetings. Short-term and long-term goals were discussed, modified, and agreed upon. The necessary changes in parlor performance and washing procedures were implemented. Employees were taught how to monitor their own performance.

In response, the employees were able to communicate problems affecting milk quality before the problems influenced the bulk tank. Udder, freestall cleanliness, and milking equipment maintenance problems were reported promptly by employees who had a sense of responsibility for producing quality milk. In addition, a technical specialist routinely visited the dairy to observe washing of equipment and cooling of milk.

Materials and Methods

Between June 2001 and June 2002 bulk tank samples were analyzed three times a week for standard plate count (SPC), laboratory pasteurization count (LPC), preliminary incubation (PI), and coliform counts. These analyses allowed the dairy to monitor the milkers’ and equipment’s performance. These tools were valuable because they are sensitive to changes in...
daily milking routine. All four tests can be affected by improper cooling or contamination of the milk samples. However, cooling failures did not occur, and sample contamination was rare. Therefore, the samples were fair representations of whether milker efforts and equipment cleanliness were adequate.

**Milking Equipment**

*Standard Plate Count* is a good indicator of sanitation and determines the total number of bacteria in a sample of milk that grows and forms countable colonies on *Standard Methods Agar* when incubated aerobically at 32°C (90°F) for 48 hours. Poor washing of milking equipment, cooling and milking routine cleanliness are possible causes of high bacterial counts. The SPC goal should be less than 5,000 colony forming units per milliliter of milk (cfu/ml).

*Laboratory Pasteurization Count* is an excellent tool for monitoring milking equipment and bulk tank cleanliness, including fat and mineral deposition on inflations and all other rubber and plastic parts. Cracks or material deterioration can increase this count. This count is performed by heating the milk sample to 62.8°C (145°F) for 30 minutes (simulates batch pasteurization) then cooling to 10°C before culturing using the SPC procedure. This procedure counts the bacteria that survive pasteurization. The LPC goal should be less than 50 cfu per ml.

**Monitoring Milker Performance, Milker’s Training**

*PI Counts* are indicators of udder and milking parlor cleanliness. They are performed by holding a milk sample at 12.8°C (55°F) for 18 hours, followed by the SPC procedure. This incubation temperature selects for bacterial contaminants in a sample that can grow at cool temperatures. The goal is no more than 10,000 cfu per ml.

*Coliform Counts* (COLI) are an excellent indicator of the cleanliness of the teats, the milking units, the workers’ hands, and the parlor floor. Milk samples are cultured on agar plates, and the total numbers of coliforms are identified. The goal should be less than 100 cfu of coliforms per ml in any sample.

Prior to June 2001, Hispanic workers had been given basic training in milking technique but had not been included in ongoing decision-making to improve milk quality through their milking practices. In June 2001 we began a training course for the milkers to help improve milk quality on the farm. These sessions included basic milking routine, monitoring milking cleanliness, and milking equipment maintenance.

Training sessions included analysis of the current milking routine that took into account the milker’s training and abilities, cow flow, and practices designed to produce high quality milk. Milkers were instructed on the value of monitoring bacteria counts that affect quality milk. Problems in milking and cleaning routines were identified and short-term and long-term goals were developed. Following each session, these routines were immediately implemented in the parlor, analyzed, and discussed so that the procedures were acceptable to the whole farm team.

### Results

Because of these training sessions, the milkers’ attitude improved when they became involved in the decision process for changes in the milking protocols that lead to improvement in milk quality. This included improvement of their understanding of the quality process and the changes needed in the milking process to correct the problems (high bacteria counts). In these sessions each milker had equal input for suggestions on procedures that could be implemented to reduce bacteria counts in milk. This involvement resulted in a better acceptance of changes and greater interest in the bacteria monitoring reports.

Of the milk produced following implementation of the new procedures (1,460 tanker loads each year) the PI counts less than 10,000 cfu/ml improved from 5 to 74% of annual loads (32,175,000 pounds), with a 10 percentage unit improvement than 10,000 cfu/ml improved from 25 to 74% of annual loads. Similarly, the goal of SPC (<5,000) loads shipped with less than 50 cfu/ml of LPC increased from 24% in 2001 to 51% in 2002. Similarly, the goal of SPC (<5,000) increased from 32% to 78% of loads. These results met milk quality goals and premiums in each category (Table 1).

### Summary

The training program improved milk quality and increased yearly quality premiums and net income. Therefore, the time committed to employee training and the effort made to involve personnel in team decisions paid off by improving milk quality. However, these training sessions were more successful when the training was in Spanish because everyone was able to contribute to and understand the monitoring process better. Farms utilizing Hispanic labor need to incorporate a mastitis/milk quality specialist who speaks Spanish and understands the Hispanic culture as well as the farm goals when developing a team approach in problem solving on the dairy.
Providing training for dairy farm employees always has been a challenge. But, cash flow shortages and incorporation of employees of Hispanic origin on many farms has increased the challenge. Training classes and language tools can help you train a more effective work force for your farm.

**DEEP**

The Dairy Employee Education Program (DEEP) offers classes conducted by MSU field and campus staff to improve employees understanding of specific farm tasks. Programs include classroom instruction and “hands-on” laboratories conducted on the farm. Evaluations of the participants have shown an increase in knowledge and understanding of their job. In addition, each has a renewed enthusiasm for their job after taking the program.

DEEP has six active modules that may be offered in your local area. They include the popular **Feeder Training** and **Calf Care Schools** plus the **Hoof Care Clinic, Herd Health Skills, and Heifer and Dry Cow Skills. The Power of People** is a companion program designed to assist and better enable farm managers and supervisors to improve employees’ performance. During the past year the following modules were held or scheduled: a Calf Care school in Clarksville and Fowlerville, Feeder School in Alpena and St. Johns, Herd Health Skills in West Branch, Falmouth and Ellsworth, Hoof Health Clinic in Hillsdale, and Power of People in Allegan and Cass City. Contact the extension dairy agent in your region to help schedule a module of interest or learn of ones scheduled in your area.

Michigan Farm Bureau offers safety-related employee training. These programs will help farms meet training needs for confined space, fork lift, electrical, and ergonomics regulations. These programs are part of the Regulatory Compliance Assistance Program (RCAP) and are fee based. For more information contact Craig Anderson, Michigan Farm Bureau, at 1-800-292-2680 ext. 2311.

**Hispanic Resources/Assistance**

Larger dairy farms in many Michigan counties have hired Spanish-speaking Hispanic employees in recent years. Communications can be a problem due to language barriers between supervisors and employees. Here are some resources to help overcome this language problem.

**Dairy Spanish Phrases.** Following Spanish classes in 1999 and 2000 in west Michigan, it was decided to develop an audio and CD-rom tool on English to Spanish phrases specific to dairy. It can be an effective training tool for employees learning English and for employers wanting to gain Spanish language skills. The set of CD-rom and audio tape costs $20 and is available from the MSU Bulletin office at 517-355-0240.

**U. Wisconsin Hispanic Resources.** The University of Wisconsin has compiled an extensive list of print, video and other resources on Hispanic labor for dairy farms. This PDF document can be found at the Center for Dairy Profitability website at http://cdp.wisc.edu. From the main page select Papers and Publications, then Management where you will find the Hispanic Resources document. Adobe Acrobat is required to view the document.

**U. Wisconsin Babcock Institute.** The Babcock Institute at the University of Wisconsin has two tools of interest. An English/Spanish Dairy Term Translator where you type in the word in English and search for the Spanish counterpart, can be found at http://babcock.cals.wisc.edu/glossary_eng.html. In addition, there is a listing of dairy terms at http://babcock.cals.wisc.edu/glossary2/terms_a_eng.html. These terms can be sorted alphabetically. Use these resources, for example, to develop standard operating procedures or work sheets for milkers or manure applicators.

**Telamon Corporation.** Telamon Corporation is a state-wide non-profit community based organization administering several key programs. The National Farmworker Jobs Program was designed to assist agricultural workers in Michigan. Telamon was a partner in the Dairy Labor Training Program that was conducted at Kellogg Biological Station from 1995 to 1997. They may be able to offer employment training services to you as an employer, such as customized classroom training, On-The-Job training (where employers can receive up to 50% wage reimbursement), and referrals for job openings. For example, there may be financial support to pay workers and instructors for English language classes for your employees. Together, several farms could establish a language class by finding an instructor at a local school, Intermediate School District or a Hispanic center. Contact John R. Hernandez, Deputy State Director in the Lansing office by calling 1-800-782-7831 ext. 13 for a Telamon office near you.

**Summary**

Employee training and effective communication are required in any business to obtain financial and quality goals. On the dairy farm, it can result in development of standard operating procedures to eliminate antibiotic residues in milk and optimize quality premiums paid. Improved communications can improve morale and reduce frustration for both employees and managers. Supporting your employees participating in a training program shows them you care and are committed to them and the work they do. In turn, your employees become more motivated and productive.
Fertility of dairy cows is influenced by a number of factors, primarily related to management and environment of the herd. Dairy producers continually look for ways to improve management or minimize the negative effects of environment in an effort to improve reproductive performance of their cows.

Genetics also influence reproductive performance in dairy cows. Genetic recessives and increasing levels of inbreeding can influence fertility. Another significant genetic influence may be caused indirectly by selection emphasis for milk production. The genetic correlation between milk yield and days open (not pregnant) is about +0.35, indicating that days open tend to increase as milk yield increases. As we have selected for higher milk production over time, we indirectly have selected for longer periods of days open.

Heritability of female fertility is about 4%. This means that improvement in cow fertility due to genetic selection will occur at a relatively slow rate. Nonetheless, given the significant economic importance of getting cows pregnant, some selection for improved cow fertility may be justified in a herd’s genetic program.

### Genetic Evaluations for Cow Fertility

The USDA Animal Improvement Programs Laboratory (AIPL) has developed genetic evaluations for cow fertility. Data used to calculate days open are from DHI records. Days open are determined in several ways. The most reliable computation is based on the last insemination date and verified by a subsequent calving date. If no insemination dates are available, 280 days (average gestation length) is subtracted from the calving date to compute the days open in the previous lactation. For cows culled for reproductive reasons, a large value of 250 days open (somewhat arbitrary) is assigned.

The genetic evaluations include adjustments for known environmental factors, including age of the cow and contemporary group (based on month of calving and lactation number). Season of calving has a significant effect on days open. Cows calving in the fall have the fewest days open, while cows calving in the spring have more days open.

### Daughter Pregnancy Rate

Genetic evaluations for cow fertility are expressed as Daughter Pregnancy Rate (DPR). Pregnancy rate in a herd is calculated by dividing the number of cows that become pregnant during a given 21-day period by the number of cows eligible for breeding during that time frame. Although the original data available for the genetic evaluations are days open, 21-day DPR can be obtained using a simple calculation.

The Predicted Transmitting Abilities (PTA) for DPR were first released by the USDA-AIPL in February 2003. PTA DPR reflects the amount by which daughters of a particular sire are expected to exceed or to fall short of your herd’s average 21-day pregnancy rate. For example, let’s assume the average 21-day pregnancy rate of your herd is 19% and you use Bull A with a PTA DPR of 1.5%. In your herd, you would expect daughters of Bull A to have an average 21-day pregnancy rate of 20.5% (19 + 1.5).

A 1% increase in DPR is equivalent to a decrease of 4 days open. If we compare Bull A (PTA DPR = 1.5%) with Bull B that has a PTA DPR of -0.5%, the difference in DPR is 2.0. Or expressed relative to days open, the average days open of Bull A daughters will be about 8 fewer days.

In the February 2003 USDA-AIPL genetic evaluations of active Al Holstein sires, the average for PTA DPR is -0.3%. The PTA DPR ranged from +2.6% to -4.1%. The magnitude of the difference between the highest and lowest bulls for PTA DPR is 6.7%, which is equivalent to a difference of 27 days open (6.7 times 4 days open). The standard deviation of PTA DPR is 1.0%, so about 2/3 of the active Al Holstein sires have PTA DPR between -1.3% and +0.7%. The average reliability for PTA DPR of active Al Holstein sires is 63%.

### Key Considerations

A PTA DPR will not be available when a bull’s first proof for milk production is released. Daughters of bulls must have the opportunity to become pregnant before PTAs for DPR can be computed. For herds that do not report inseminations, daughters must calve again before days open can be determined. PTA DPR could be available three or more sire summaries after a bull’s initial production proof.

Reliabilities for PTA DPR will be lower than reliabilities for PTAs for production traits of bulls with only first-crop daughters. Because DPR has a heritability of only 4%, many more daughter records are needed to reach a reliability of 99% compared with a trait such as milk yield with a heritability of 30%. For bulls with PTAs based on first-crop daughters only, reliabilities of PTA DPR will be about 45 to 60%.

DPR is based on factors influenced by the cow, including the cow’s ability to return to normal reproductive status after calving, to show visible signs of estrus, to conceive when inseminated, and to maintain the pregnancy. DPR differs from ERCR (estimated relative conception rate), where ERCR is a measure of a bull’s influence on fertility.

Future plans are to incorporate PTA DPR into Net Merit (NMS). This will allow PTA DPR to be included in a sire selection program based on an appropriate economic...
Edible Films or Coatings

Edible films or coatings, defined as continuous matrices that can be prepared from proteins, polysaccharides, and (or) lipids, have a long and rich history. Yuba, the first freestanding edible film, was developed in Japan from soymilk during the 15th century and used for food preservation. Edible coatings for food products date back even further with waxes applied to oranges and lemons in China to retard water loss during the 12th century. During the 16th century, foods were coated with fat (e.g., lard) to control moisture loss. Hot melt paraffin waxes have long been used to prevent surface mold growth on cheeses. Carnauba wax and oil-in-water emulsions have been used to coat fresh fruits and vegetables since the 1950s. Currently, edible films and coatings are used in a variety of applications including casings for sausage and other coatings for chocolate, fruit, and nuts.

Edible films typically contain three major components: proteins, polysaccharides, and lipids. Proteins used in edible films include wheat gluten, collagen, corn zein, soy, casein, peanut, and whey protein. Polysaccharide-based edible films can be prepared from alginate, dextrin, pectin, carrageenan, and cellulose derivatives. Suitable lipids for film-making include waxes, acylglycerols, and fatty acids with composite films containing both lipid and hydrocolloid components also have been developed.

Plasticizers can be added to film-forming solutions to enhance properties of the final film. These film additives are typically small molecules of low molecular weight and high boiling point that are highly compatible with the polymers. Common food-grade plasticizers such as sorbitol, glycerol, mannitol, sucrose, and polyethylene glycol decrease brittleness and increase flexibility of the film, which is important in packaging applications. Plasticizers used for protein-based edible films decrease protein interactions, and increase both polymer chain mobility and intermolecular spacing. The type and concentration of plasticizer influences the properties of protein films with mechanical strength, barrier properties, and elasticity decreasing when high levels of plasticizer are used. Water is another important plasticizer for protein films with film moisture content also impacting film properties.

Commonly used covalent crosslinking agents such as glutaraldehyde, calcium chloride, tannic and lactic acids can

References

21- Day Pregnancy Rates for Your Herd

Do you know the average 21-day pregnancy rate for your herd? Herds using PCDART can access this information using Report 126-Pregnancy Rate Summary in the DRMS Standard Report list. The pregnancy rate calculations are based on the voluntary waiting period (VWP) and days to pregnancy check information that you have reported through DHIA. Please review your settings for these values to ensure that they accurately represent your management practices. If your VWP is actually longer than the value reported through DHIA, the pregnancy rates will be affected negatively.

Increasing consumer demand for microbiologically safe foods, greater convenience, smaller packages and longer product shelf-life is forcing the food industry to develop new food processing, cooking, handling, and packaging strategies. Cooked ready-to-eat (RTE) foods frequently are subjected to post-process surface contamination leading to food safety concerns and a reduction in shelf-life.

The food industry has at its disposal a wide range of non-edible polypropylene- and polyethylene-based packaging films as well as various biodegradable protein-based edible films, including films prepared from whey protein, that potentially can serve as packaging materials. Besides acting as a barrier against mass diffusion (moisture, gases, and volatiles), whey protein films can serve as carriers for a diverse group of food additives including flavoring agents, antioxidants, vitamins, and colorants. Furthermore, when antimicrobial agents such as benzoic acid, sorbic acid, propionic acid, lactic acid, nisin, and lysozyme are incorporated, these edible films can serve as active packaging materials and retard the growth of bacteria, yeasts, and molds on the surface of RTE foods.

Hot Dog!

Antimicrobial Whey Protein-Based Casings – Coming to a Store Near You?

Arzu Cagri, Zeynep Ustunol, and Elliot T. Ryser
Dept. of Food Science and Human Nutrition

Increasing consumer demand for microbiologically safe foods, greater convenience, smaller packages and longer product shelf-life is forcing the food industry to develop new food processing, cooking, handling, and packaging strategies. Cooked ready-to-eat (RTE) foods frequently are subjected to post-process surface contamination leading to food safety concerns and a reduction in shelf-life.

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Commonly used covalent crosslinking agents such as glutaraldehyde, calcium chloride, tannic and lactic acids can
be used to improve water resistance, cohesiveness, rigidity, mechanical strength and barrier properties. Exposure to ultraviolet light will increase the cohesiveness of protein films through crosslinking. Alternatively, enzymatic crosslinking treatments with transglutaminases or peroxidases can be used to stabilize films.

**Forming Edible Films**

Three primary techniques have been developed for forming edible films - solvent removal, thermal gelation, and solidification of melt. Solvent removal typically is used to produce hydrocolloid edible films. In this process, a continuous structure is formed and stabilized by the chemical and physical interactions between molecules. Macromolecules in the film-forming solution are dissolved in a solvent such as water, ethanol or acetic acid that contains several additives (plasticizers, crosslinking agents, solutes). The film forming solution is then cast in a thin layer, dried, and detached from the surface.

In preparing some types of protein films (whey protein, casein, soy protein, wheat gluten), the solution is heated for protein gelation and coagulation followed by rapid cooling. Intramolecular and intermolecular disulfide bonds in the protein complex are cleaved and reduced to sulfhydryl groups during protein denaturation. When the film-forming solution is cast, reformed disulfide bonds link the polypeptide chains together to produce the film structure with the aide of hydrogen and hydrophobic bonding.

Melting followed by solidification is another common film-forming technique for the production of lipid-based films. Wax films also can be formed by casting molten wax on dried films of methylcellulose and then dissolving away the methylcellulose film.

Production of films from whey protein - the protein remaining in milk serum after acid/rennet coagulation of fluid milk, requires heat denaturation. Upon heating, the three-dimensional structure of whey protein is changed to expose internal sulfhydryl and hydrophobic groups that promote the formation of new intermolecular disulfide and hydrophobic bonds during drying. Glycerol, sorbitol and polyethylene glycol have been commonly used as plasticizers to produce whey protein films that are transparent, bland, and flexible, and have excellent oxygen, aroma, and oil barrier characteristics. However, these films are poor moisture barriers. Incorporating lipids such as acetylated monoglycerides, waxes, fatty alcohols, and fatty acids into the film-forming solution has been used to decrease water vapor permeability. Beeswax and fatty acids are superior to fatty alcohols for enhancing the moisture barrier properties of whey protein films with the longer chains more effectively reducing water vapor permeability.

Whey protein film properties are affected by the extent of intermolecular disulfide bonding and level of plasticizer competing for protein chain-to-chain hydrogen bonding. Plasticizer content and relative humidity both serve to increase film permeability. Tensile strength of whey protein films is higher than most other protein-based films with the opposite true for elongation. Heat curing is commonly used to cross-link synthetic polymers and improve film strength, extendibility, flexibility and moisture barrier properties.

**A Whey Protein-Based Edible Hot Dog Casing**

Slicing and packaging operations are major points at which both pathogenic and spoilage organisms can be introduced into processed meats, with sausage peeling machines cited as the major source of contamination for skinless hot dogs. As mentioned at the outset, microbial susceptibility of the food surface is a major determinant of product quality and safety during refrigerated storage and distribution. Most microbiologically related Class I recalls in the U.S. result from post-process contamination during subsequent handling and packaging rather than from under-processing with about two-thirds of these recalls due to contamination with *Listeria monocytogenes*. Since 1985, the United States has maintained its policy of ‘zero tolerance’, which mandates the recall of any cooked or ready-to eat food product found to contain *L. monocytogenes*. From January 1998 to February 2003 alone, over 130 *Listeria*-related Class I recalls involving more than 80 million pounds of cooked ready-to-eat meats were issued. In December of 1998, over 35 million pounds of hot dogs and luncheon meats were recalled voluntarily by one Michigan manufacturer in response to an outbreak that resulted in 101 cases of listeriosis in 22 states, including 21 fatalities. Recognizing antimicrobial edible films and coatings as one means to inhibit microbial growth on the surface of RTE foods, we set out to develop a whey protein-based casing that could prevent the growth of *L. monocytogenes* on the surface of hot dogs during extended refrigerated storage.

Various antimicrobial edible films have been developed to control the growth of spoilage and pathogenic microorganisms that may contaminate the surface of foods after processing. In most solid foods, contamination and microbial growth occurs on the food surface, which leads to a reduction in product shelf-life. Edible films containing various antimicrobials such as benzoic acid, sorbic acid, propionic acid, lactic acid, nisin, and lysozyme have been investigated to retard the growth of bacteria, yeasts, and molds on different product surfaces. The primary advantage of antimicrobial edible films is that the antimicrobial agents can be specifically targeted to post-processing contaminants on the food surface.

In our work, low pH (5.2) whey protein isolate (WPI)-based
edible films containing sorbic acid (SA) and p-aminobenzoic acid (PABA) inhibited the growth of *L. monocytogenes* as well as *Escherichia coli* O157:H7 and *Salmonella* Typhimurium DT104 (a multi-antibiotic resistant strain) on commonly used laboratory media (Cagri et al., 2001). Subsequently, these films were tested between beef bologna and summer sausage slices that were surface-inoculated with the same pathogens at a level of 10^6 colony forming units (cfu)/g (Cagri et al., 2002). These WPI films containing SA or PABA decreased *Listeria*, *E. coli* O157:H7 and *S. Typhimurium* DT104 populations by 99.9 to 99.99% on bologna and sausage after 21 days of aerobic storage at 4°C with the growth of spoilage bacteria, yeasts, and molds also inhibited.

After heat curing to modify mechanical properties, WPI films (pH 5.2) containing 1.0% (w/w) PABA were heat-sealed to form hot dog casings (Cagri et al., 2003). A commercial-type hot dog batter was stuffed into these casings with collagen and natural casings also used as controls. After cooking, the hot dogs were surface-inoculated to contain 10^6 *L. monocytogenes* cfu/g and then vacuum packaged. During 42 days of refrigerated storage, *Listeria* populations on hot dogs prepared with WPI-1.0% PABA casings remained relatively unchanged, whereas numbers of *Listeria* on hot dogs prepared with collagen and natural casings increased about 500-fold. Additionally, growth of spoilage bacteria was partially suppressed on hot dogs prepared with WPI-1.0% PABA casings, thereby enhancing product shelf-life.

**Prevent Growth of Listeria**

These unique WPI casings containing 1.0% PABA provide an alternative strategy to prevent the growth of *Listeria* on hot dogs with the added advantage that the antimicrobial activity is retained, even after the package is opened. One of the main challenges ahead is the development of a continuous extrusion process for WPI casing production since the current casting method is not economically viable for commercial hot dog production. One important hurdle to overcome will be the reduction of water activity in the casing formulation to enhance the extrusion process. In addition, the WPI casing formulation will need to be modified for fast heat drying since heating is an integral step in the extrusion process. Overall, this work represents an important step towards the commercialization of WPI-based antimicrobial hot dog casings that eventually may come to a store near you.

**References**


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**Industry and University**

### A Tribute to Clint Meadows

**Ted Ferris**  
and Pam Jahnke  
Dept. of Animal Science

On January 3, 2003, Clint Meadows died in Lansing at age 89. A memorial service was held on February 22 at the Okemos Community Church in Okemos, Michigan.

Meadows was born January 16, 1913 on a cotton farm in Hampstead County, Arkansas. Prior to coming to MSU, he had owned a dairy farm in Fayetteville, Arkansas, at which time he attended the College of Agriculture at the University of Arkansas, where he earned his B.S. degree in 1947. He completed his M.S. and Ph.D. degrees at Iowa State University in dairy science.

When he visited MSU for an interview in 1957, he was hired on the spot, recalled Pat Ralston, who was chair of the MSU Dairy Science Department at the time. Meadows joined MSU in 1957 as an Associate Professor and Dairy Extension Specialist. He was promoted to Full Professor in one year. Meadows stated three goals during his interview: to take care of his family, to “do a good job” and to enjoy sports, especially football and basketball. (Meadows was a former high school mathematics teacher and football coach in Arkansas and Louisiana and former high school and college athlete.)

**References**


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**Extension Program**

The major components of Meadows’ extension program were the use of DHIA records for making herd management decisions, culling poor producing cows based upon estimated 305-day lactation records, use of a young sire sampling program based upon the science of dairy cattle breeding, and good cow management techniques.

Perhaps the greatest impact came from his efforts to help AI organizations construct well designed young sire programs, which provided the AI industry with significant permanent advancements in milk production. Meadows often coached AI sire analysts, students, and colleagues on the components of a successful young sire sampling program. The end result was better sires each year and AI units found some truly great sires (outliers) by sampling enough young sires each year; the more bulls sampled the greater the chances of finding an outstanding sire. Meadows’ instructions often
involved the formula for Reliability, which included the number of bull daughters and the number of herds. Using this formula, he pointed out to AI studs that one daughter per herd in 40 plus herds was the basis for a good first proof for a bull.

**His Test Herd**

Shortly after joining MSU, Meadows organized a test herd at MSU’s Kellogg Biological Station, where he applied advanced sire selection, taking an ordinary herd of Guernsey dairy cattle and making it nationally known for its high production and breeding value. He visited many Michigan and US dairy farms about the advantages of improved herd management practices.

While at MSU, he quickly established himself with his academic colleagues as well as those affiliated with the Michigan dairy industry, building a strong dairy cattle genetics and management program. But, perhaps he will be remembered most for combining scientific discoveries and techniques with useful applications, such as his “Dairy Slide Rule” that he invented and patented. The device actually is a calculating wheel that estimates an individual cow’s 305-day lactation milk production from her early lactation performance. “This tool was the predecessor of computerized 305-day records, and it assisted dairy producers throughout the country in improving their herds by identifying the poor-producing cows” said Ted Ferris, Animal Science Professor.

In the early 1970s Meadows worked with several colleagues and Select Sires, Inc. to formulate the young sire progeny testing scheme that provided significant advancement to the Select Sires’ bull line-up. “Clint spent many hours and many trips to Ohio to work with Select Sires and their Young Sire Committee of dairy producers and Select Sire’s staff”, said Ferris. “As a result, milk production per cow increased in the United States through improved cattle, more profitable dairy farms evolved”.

**The Recipient of Many Awards**

Throughout his career, Meadows received numerous awards from local, state and national organizations, for his involvement with artificial insemination and statistical sire selection practices. In 1995, he was inducted in the National Dairy Shrine’s Hall of Fame. He also was honored by the Michigan Legislature and received distinguished service awards from the Michigan Farm Bureau, Michigan Animal Breeder Association, the Michigan Milk Producers Association, and Michigan State University.

A war hero, husband, and father of two sons, Meadows retired in 1978 as Professor Emeritus and a Distinguished Faculty member. The Clinton E. Meadows Endowment Chair was established in 1979 in honor of his many achievements.

Several close colleagues and former students from MSU gave eulogies at the memorial service on Meadows.

During the service, friends of Meadows recalled his ready smile, trade-mark brimmed hat and, of course, his tobacco pipe. His warm sense of humor was apparent to those who knew him as well as his love of the outdoors, whether he was fishing for bass or visiting a farm.

Ralston said, “His reputation grew over the years because of his magnetic personality, his friendliness, and often frankness, and as a loyal person of the dairy industry.”

A former graduate student and MSU Extension Dairy Agent, George Atkeson, said not all of Meadows’ students were the academic kind. “Records were his life! His best classroom was in the cow barn or at a producer’s kitchen table. He was a master at making the complex simple, practical, and understandable.”

**Not Quite Retired**

Even in retirement, Meadows continued to hone his skills, said Rodger Hoyt, former director of young sire sampling at Select Sires, who also noted that Meadows continued to attend sire committee meetings up until a few years ago. “It was surprising how he kept up on the latest genetic evaluation procedures throughout his retirement. Truly he was an amazing individual.”

Ivan Mao, retired MSU Professor, said, “I didn’t take any degree under Meadows. But I, like many others, was his student. Meadows was beyond knowledge and science, it was common sense, putting matters in perspective, what’s important and immediate in the practical world, communication styles and skills, and a healthy dose of humbleness expressed in a self-deprecating style of humor. As funny and casual as he always appeared, however, he always was well prepared ahead of time. According to Meadows, any motive or action was either out of passion or ambition, and how true he was. He respected passion, and it was his way. Out of fondness and respect, I’ve maintained a close relationship with him sharing our passion, in all of these years before and after his retirement. A lot of our discussions took place over long lunches at the Big Boy restaurant in Okemos, where he got most of his teaching done.”

A friend and fellow dairy industry retiree, Jim Day, said: “I will long remember Clint as a man of gentle strength who said the right words, showed compassion when warranted, verbally blistered your hide when it too was warranted and remained a great friend and mentor.”

Meadows is survived by his wife of 60 years, Edna Jane Meadows; two sons, Lee and Mark, and two grandchildren.

Donations can be sent to the Clinton E. Meadows Endowment Chair of Dairy Management, c/o MSU Foundation, 4700 S. Hagadorn Road, East Lansing, MI 48824.
MSU Dairy Judging Team Competes in Texas

Joe Domecq  
Dept. of Animal Science

The MSU Collegiate Dairy Judging team traveled to Ft. Worth, Texas to compete in the Southwestern Exposition and Livestock Show dairy judging contest in January. Team members included Ashley Liddy (Gladwin), Lindsay Kirk (St. Johns), Kristin Kramer (Harbor Beach), and Beth Munsell (Fowlerville). The team placed 5th in reasons, 3rd in Brown Swiss, 5th in Jerseys, and 4th overall in the contest. Individually, Ashley was 4th in Jerseys, 9th in Holsteins, and 9th overall. Several thousand head of livestock and horses are exhibited at the Livestock show and team members were able to observe several different breeds being shown, including Texas Longhorns. During the 3-day trip, the team also had the opportunity to visit a dairy operation in Oklahoma, visit the old stockyards in Ft. Worth, and tour the Oklahoma City bombing memorial.

Several organizations provide financial support to the MSU Dairy Judging program which enables the team to travel to various contests. Those sponsors include ABS Global, Michigan Dairy Memorial Foundation, Michigan FFA Alumni Association, Michigan Holstein Association, Northstar Cooperative, Inc. and the United Dairy Industry of Michigan. Team members also participate in fund raisers throughout the year, including the Spartan Spectacular Calf Sale held every March. The team is coached by Joe Domecq and assisted by Laurie Davis.

Calendar of Events

June 3-4. The Annual CIP (Clean-In-Place) Short Course will be offered from 8:00 a.m. to 5:00 p.m. at the MSU Dairy Foods Complex. The short course will present the latest CIP knowledge in both classroom and demonstration sessions. The registration fee is $595.00 for a single participant or $545.00 per person if two or more from the same company register. Contact Linda Young at 517-355-8474, E-14 for further information.

June 18-20. The 4-H Exploration Days will be held at MSU with different educational and fun workshops available to 4-H members. Three workshops specifically for youth with an interest in dairy are available. Workshops include Dairy Products, AI and Ultrasound Use in Dairy Cattle, and Fitting and Showing Dairy Cattle. Each workshop has limited space and registration is due by May 2. For more information about 4-H Exploration Days, please contact your county MSU extension office, or check the following website www.msue.msu.edu/cyf/youth/expodays.html or Dr. Joe Domecq, 4-H Dairy Youth Specialist at (517)353-7855.

June 25-26. The 66th Annual Michigan Milk Producers Association (MMPA)/4-H Milk Marketing Tour will be held at MMPA's Novi office. The tour is designed for students between the ages of 15 and 19 who have an interest in milk marketing and the dairy industry. The tour introduces participants to cooperatives, milk pricing, milk processing, milk testing procedures and careers in the dairy industry. MMPA provides all registration, lodging and meals. The only cost to the participant is transportation to Novi. A tour registration form is being sent to Extension offices, FFA advisors and MMPA members. The deadline for registration is June 4 and will be limited to the first 30 students who sign up. Participants do not have to belong to 4-H or FFA to attend the tour. For more information, contact the MMPA Member Relations Dept. at (248) 474-6672 or Dr. Joe Domecq, State 4-H Dairy Youth Specialist at (517)353-7855.

July 21-25. Michigan Dairy Expo (MDE) and 4-H Dairy Days is scheduled for the week at the Pavilion on the MSU campus. The Michigan Youth Dairy Show, the Michigan Youth Dairy Judging Contest, as well as the Michigan 4-H State Dairy Quiz Bowl and Management contests will be held during MDE. The heifer calf giveaway has become a highlight of the MDE. Youth that participate in the various events have the chance to win a heifer calf. The Great Dairy Adventure, where over 2000 consumers learn about the dairy industry and dairy products also takes place at MDE. Each state breed association holds their summer show during MDE. Entries for all youth events are due at county extension offices by June 23. For more information about the Michigan Dairy Expo, please contact your county MSU extension office, or Dr. Joe Domecq, State 4-H Dairy Youth Specialist at (517)353-7855.
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