Dry-Cow Therapy: *Choosing the Best Protocol for Your Dairy*

MISSISSIPPI STATE UNIVERSITY EXTENSION

The dry period is typically referred to as the end of a lactation, but it should really be considered the beginning because of the changes taking place in preparation for the next lactation. During this period, the cow is undergoing a considerable amount of anatomical and physiological changes. The metabolic and mammary changes that occur during this time can either help or hinder the next lactation. This publication provides information to help producers make dry-cow decisions that work for their herds.

Dry-Cow Mastitis Risk

Dry period length greatly affects the next lactation. For the cow to reach maximum milk production, a 45- to 60-day dry period is required. If proper management techniques are not used during this period, the cow will be more susceptible to an intramammary infection. An intramammary infection (mastitis) can lead to an economic loss for the upcoming lactation. Each mastitis case costs about $325, mostly due to milk production losses and treatment costs.

The last 2 months of gestation allow the fetus to complete almost two-thirds of its total growth. The needs of the fetus are prioritized even over the cow's need to maintain body condition. During the 45- to 60-day dry period, the cow needs to quickly adjust from an energy-dense lactating-cow ration to a ration that just meets basic requirements. The cow is using the majority of her nutrients for the fetus, but, within the udder, cellular changes are also taking place. Udder involution refers to the remodeling of the udder, when the milk-producing cells shrink and repair themselves in order to grow and start making milk again. As calving approaches, a period of intense mammary growth needs to occur so colostrum can start being produced.

Due in part to these rapid changes occurring in the udder, the risk of new intramammary infections is highest during the dry period. This can lead to mastitis that may not be detected until the beginning of the next lactation or later. Cows are especially susceptible to infection in the days immediately following dry-off and in the 3 weeks before calving. Factors that can contribute to elevated susceptibility to infection include

- an accumulation of milk in the gland for the first few days;
- the cessation of teat-end disinfection;
- environmental influences; and
- an impaired immune system.

Forming a keratin plug in the teat canal is the cow's natural defense mechanism against intramammary infection at dry-off. A keratin plug is a wax-like substance that acts as a physical barrier and makes entering the teat canal more difficult for invading bacteria. However, the keratin plug is not fully developed until several days into the dry period. And approximately 3 weeks before calving, the keratin plug will start to break down in preparation for the new lactation, which can allow for milk leakage and an opportunity for bacteria to enter the teat.

In a New Zealand study, about 50 percent of teats had not formed a functional keratin plug 10 days after dry-off, with about 5 percent still not forming after a full 60 days. This same study found that 97 percent of quarters that had not developed a functional keratin plug had mastitis in the early dry period. When an intramammary infection is contracted during the dry period, it can increase the risk of clinical mastitis, which is observed in the next lactation by visual changes to the udder and milk.

Both contagious and environmental pathogens can contribute to infection during the dry period, just like during lactation. Dry-period mastitis has an added complexity, though, because both new infections and remaining bacteria from the previous lactation contribute to mastitis. About 10–17 percent of quarters contract new infections during the dry period, with the majority of infections being caused by environmental pathogens like *E. coli* or *Klebsiella*.

Intramammary infections present at calving can reduce milk yield by 5 percent throughout the lactation. Therefore, the goals of dry-cow therapy are to eliminate any current

intramammary infection at dry-off and to prevent any new infections from occurring during the dry period.

Subclinical mastitis occurs when no visual changes are observed in the udder or milk, but bacteria have entered the mammary gland and caused an intramammary infection. These cases are not easily detected and can only be found by doing a bacteriological milk culture or somatic cell count test (SCC > 200,000 cells/mL represents subclinical mastitis). Subclinical mastitis is present in about 40–50 percent of cows 2 weeks before dry-off to 2 weeks after dry-off.

In addition, new infections typically occur in about 10–15 percent of cows not treated with an antibiotic at dry-off. Dry-cow antibiotics are effective for treating cows with both clinical and subclinical mastitis. The cure rate of mastitis from existing intramammary infections at dry-off is greater compared to treatment during lactation, especially for *Staphylococcus aureus* bacteria. This is likely because dry-cow antibiotics contain a higher antibiotic dose than lactating-cow antibiotics; therefore, the antibiotic is retained in the udder longer.

Several factors go into choosing the appropriate management strategy to be used on-farm. Although this publication provides options on dry-cow therapies that may work for your operation, protocol decisions and changes should be discussed with your veterinarian before implementation.

Blanket Dry-Cow Therapy

For more than 60 years, blanket dry-cow therapy, or infusing antibiotics into all quarters of all cows at the end of the lactation, has proven to be the most effective means of eliminating existing infections and preventing new infections during the dry period. The use of blanket dry-cow therapy is estimated to be 72 percent in the United States and 88 percent in Canada. In 2014, the USDA reported that 90.8 percent of dairy operations used some antibiotics on at least some cows at dry-off.

Research shows that 90 percent of existing mammary infections can be cured by treating with antibiotics at dry-off. For example, *Streptococcus agalactiae* used to be common on dairies because it is easily spread from cow to cow. However, *Streptococcus agalactiae* is very susceptible to antibiotics and has been eradicated in many herds solely through the use of blanket dry-cow therapy. Blanket dry-cow therapy can be 90–93 percent effective against subclinical *Streptococcus agalactiae* infections, 70–80 percent effective against *Staphylococcus aureus* infections, and 70–90 percent effective against infections caused by environmental *Streptococci*. The use of blanket dry-cow therapy has also reduced bulk-tank somatic cell count and clinical mastitis incidence in herds.

Although blanket dry-cow therapy is the most common protocol used in North America, many European countries have banned this practice due to the rising concern of antimicrobial resistance. No evidence suggests that blanket dry-cow therapy has led to antibiotic-resistant mastitis pathogens, but increasing pressure to reduce antibiotic use has forced producers to find alternatives to blanket dry-cow therapy. However, keep in mind that the only well-established recommendation for dry cows is the use of blanket dry-cow therapy, so any decision to deviate from that should not be taken lightly.

Selective Dry-Cow Therapy

An alternative strategy to blanket dry-cow therapy is selective dry-cow therapy. Selective dry-cow therapy allows producers the option to decrease the use of antibiotics in their herd by treating cows only at the quarter or cow level at dry-off. In the Netherlands, blanket dry-cow therapy is considered preventive use of antibiotics and has, thus, been banned since 2013. Producers have now adopted selective dry-cow therapy. A selective dry-cow therapy program can save producers money initially on antibiotic expenses at dry-off, but this program can lead to negative economic consequences from increased mastitis and SCC compared to cows treated with blanket dry-cow therapy. When using this approach, antibiotic use is typically determined based on the infection status of each quarter or cow and SCC records. Implementing a selective treatment regimen requires diligent record-keeping, patience, and commitment.

Multiple methods exist to select cows to treat, but, although many methods have been researched, none stand out as being perfect. Selection criteria can include bacteriological culture results, SCC, clinical mastitis history, Minnesota Easy 4Cast plate (University of Minnesota, St. Paul, MN), and California Mastitis Test (CMT) (ImmuCell, Portland, ME) results. Producers can choose to select cows based on quarter-, cow-, or herd-level criteria. For example, with the quarter-level approach, producers could run milk bacteriological cultures on individual quarters of cows nearing dry-off and treat only quarters that have bacteria present. At the cow level, if a cow has an intramammary infection in any quarter based on culture results, the producer could treat all four quarters with an antibiotic. Different methods of selection have varying levels of accuracy in identifying infected cows, so they can have very different results.

When choosing cows for a selective dry-cow program, using an accurate diagnostic test is crucial to ensure the cows that need to be treated are actually treated. The CMT is commonly used to detect clinical mastitis and is a useful tool in doing so. However, in a Missouri study, CMT

resulted in only 70 percent sensitivity and 48 percent specificity, meaning that the CMT correctly identified 70 percent of the cows that had clinical mastitis and correctly identified 48 percent of the cows that didn't have clinical mastitis. Therefore, the CMT may not be the most accurate tool for identifying subclinical mastitis cases for a selective dry-cow therapy program.

Bacteriological culturing provides the infection status of the cow and identifies the bacteria that caused the infection. With this information, an effective antibiotic can be selected for treatment. Cultures can be sent to an off-farm lab to be incubated and read, but it may take up to a week to receive the results. With the availability of on-farm culture systems, producers are able to obtain culture results in just 24 hours. On-farm culture systems are relatively inexpensive, costing about $3 per test, plus $50–100 for the initial incubator purchase.

In one study, quarters that were dried off without antibiotics were 3.7 times more likely to acquire clinical mastitis compared to quarters that were dried off with antibiotics. With the relatively low cost of dry-cow antibiotics, the initial money saved from using selective dry-cow therapy may be used to treat cases of mastitis after calving.

Researchers in the Netherlands studied using blanket dry-cow therapy versus selective dry-cow therapy on groups with different SCC thresholds. The cost of using blanket dry-cow therapy on a herd of 100 cows was $5,937. For a herd of 100 cows that were selectively treated at a SCC threshold of 50,000 cells/mL, the expense was $5,791. For a herd of 100 cows that were selectively treated at a SCC threshold of 150,000 cells/mL, the cost was $6,159. These costs include the price of antibiotics, milk production losses, and labor expenses. In this experiment, using selective dry-cow therapy with a low SCC threshold, producers only saved about $34 per 100 cows. A majority of the expenses seen in the selective dry-cow therapy programs come from treating mastitis cases post-calving. Therefore, economics alone should not sway producers to selective therapy over blanket therapy.

Researchers in Canada compared milk production and SCC in the first 180 days of lactation between

- cows that received blanket dry-cow therapy plus an internal teat sealant; and
- cows that were selectively treated, based on an on-farm bacteriological culture, with dry-cow antibiotics plus an internal teat sealant.

Cows in the selective group that had a negative bacteriological culture were infused with an internal teat sealant only. The results from this study indicate that there were no differences in milk production or SCC in the first 180 days of lactation between the treatment groups.

Results from multiple studies have provided evidence that cows that receive antibiotics at dry-off have a lower SCC in the next lactation than untreated cows. This demonstrates the importance of providing some sort of protection for quarters of the cows that do not receive antibiotic treatment during the dry period, such as an internal teat sealant. When dry-period risk factors that are associated with a high SCC in early lactation were examined, researchers concluded that no differences in SCC in early lactation were observed when using blanket therapy or an internal teat sealant alone in cows with a low SCC (≤ 200,000 cell/mL).

Teat Sealants

Dry-cow therapy programs can include an internal or external teat sealant, regardless of the antibiotic treatment regime. Teat sealants give an added layer of protection from potential pathogens. An external teat sealant, or barrier teat dip, is a dip that forms a film and adheres to the teat end. Many industry representatives recommend using the external teat sealant at dry-off but then applying a second time 2 weeks before calving.

Factors that can influence the duration of the sealant include the season of application, teat characteristics, and sealant formulation type. The average duration of sealant adherence to the teat ranges from 1.5 to 7.2 days. Several companies have external teat-sealant products on the market that will vary in adherence length.

Researchers have found longer adherence when an external teat sealant is applied in the spring or winter compared to the summer or fall because the sealant forms a thicker barrier during cooler temperatures. Longer teats tend to have a longer-lasting adherence compared to shorter teats because, with shorter teats, the sealant has a smaller surface area to adhere to and is more likely to drip off during application.

Teat ends close at varying rates depending on the individual cow, and about 50 percent of teats may still be open up to 10 days after dry-off. Therefore, the protection provided by external teat sealants is not reliable for the entire dry period and does not compare to the protection provided by internal teat sealants.

An internal teat sealant is a putty-like paste that is administered into the teat canal at dry-off. The paste fills the teat canal (the hollow space inside the teat), forming a tight seal that is more secure than a natural keratin plug. Internal teat sealants provide a barrier inside the teat to prevent pathogens from entering the teat canal throughout the dry period. **Figure 1** represents the cross-section of a teat with an external teat sealant, a natural keratin plug, and an internal teat sealant.

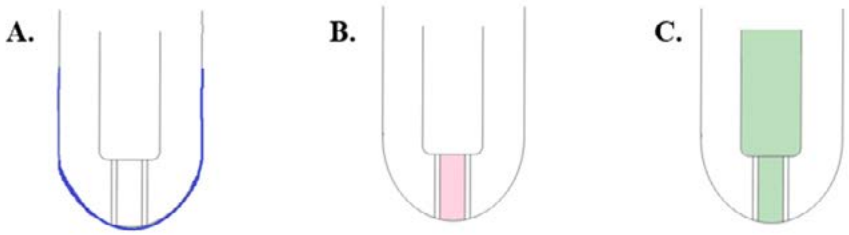

Figure 1. Cross-section of a teat with protection from A) an external teat sealant, B) a natural keratin plug, and C) an internal teat sealant.

Sealants are available to be used alone or in combination with intramammary antibiotics. If used without an antibiotic, producers should conduct milk bacteriological culture to be sure that each quarter is uninfected. If a cow has an existing mammary infection and isn't treated with an antibiotic at dry-off, using an internal teat sealant alone will contain the infection inside the quarter. This will allow the infection to incubate in the quarter throughout the dry period.

It can be beneficial to treat cows at dry-off with an intramammary antibiotic and an internal teat sealant. In one study, cows were treated at dry-off with either an internal teat sealant alone or with an internal teat sealant in combination with an antibiotic. Cows were put into groups based on infection status, either high-SCC infected or low-SCC uninfected. Cows in the high-SCC infected group had an SCC > 200,000 cell/mL and at least one case of clinical mastitis in the 3 months before the start of the study. Cows in the low-SCC uninfected group had a SCC < 200,000 cells/mL and no clinical mastitis for the 3 months before the study. When cows that were in the high-SCC infected group were treated with the combination of antibiotics and internal teat sealant, they were less likely to become infected with mastitis in the next lactation. However, no clear benefits were observed in the cows in the low-SCC uninfected group that were treated with the combination of antibiotics and an internal teat sealant.

In a New Zealand study, researchers treated bred heifers with an internal teat sealant alone, a dry-treatment antibiotic injection alone, or both an antibiotic injection and an internal teat sealant. Each treatment group was evaluated for the cure of existing intramammary infections and the prevention of new intramammary infections. Dry treatment with an internal teat sealant alone or an injectable antibiotic alone did not increase the cure rate for existing intramammary infections. However, the treatment group that received the teat sealant alone had a reduced risk of a new intramammary infection caused by any pathogen by 74 percent and a reduced risk of post-calving intramammary infection by 65 percent. Internal teat sealants alone in heifers can be a useful tool for reducing the risk of mastitis.

Reducing Milk Yield before Dry-Off

High production at dry-off is associated with higher risk of intramammary infection during the early dry period due to increased intramammary pressure. With lower milk production at dry-off, intramammary infection risk can be reduced both during the early dry period and at calving. Reduced milking frequency (for example, one time per day versus two times per day) is a management practice that can be used before dry-off to reduce milk yield. This practice is sometimes used in combination with feeding a lower energy ration. By decreasing milking frequency during the last week of lactation, production can drop by 22–47 percent.

Feed restriction has been used as a method to reduce milk production before dry-off, but this practice comes with some animal-welfare concerns. In a Swedish study, researchers evaluated the effects of two different feeding strategies 1 week before dry-off until the day of dry-off on certain health aspects. One treatment group had free access to straw, and the other treatment group had free access to straw plus was offered silage once a day. Based on the results, the treatment group that was fed only straw during dry-off had elevated levels of cortisol, a stress hormone. Cortisol levels decreased again after the dry-cow ration was introduced. Because the cows fed straw and silage did not have this response, the researchers concluded that the elevated cortisol levels were associated with the feed restriction, meaning the cows were stressed because they were hungry. When a dairy cow experiences a stressful situation, such as hunger, the increased secretion of cortisol can lead to reduced immune-system activity. If the immune system is compromised, infections and diseases may develop.

Feed restriction has been shown to reduce milk yield, udder firmness at dry-off, milk leakage, and rate of infections caused by *Streptococcus uberis*. However, cows that were offered less feed spent less time eating and more time lying, and they were more vocal than the cows offered more feed, which could indicate hunger and welfare issues. Reducing milk yield should be done in a way that takes the cow's health and comfort into consideration. Restricting feed is an animal-welfare concern and is not a recommended practice for dry-cow management.

Starting a lower energy diet a week before dry-off can begin to reduce milk production. Offering the same amount of feed but lowering the energy content potentially can be a more humane way to reduce milk production. If feeding a TMR, cows should be moved to a new environment separate from the lactating cows and fed a lower energy ration. This often can lead to a loss of body condition because there is a smaller amount of nutrients available, and those nutrients are being absorbed and used for the fetus's growth instead of maintaining body condition.

Ideally, the dry cow will maintain the same body condition, without gaining or losing, throughout the dry period. It is important for the cow to maintain body condition during this period. At the start of lactation, cows rely on the mobilization of body-fat storage to counteract the negative energy balance they often experience. At drying off, body condition should be close to what it should be at calving. With a poor body condition, cows will drop off in production and are harder to get bred back.

Mastitis Vaccinations

Dry-off is a good time to make sure cows are up-to-date on all vaccines recommended by your veterinarian, and it is also a good time to implement a coliform mastitis vaccine. Coliforms are environmental pathogens that are often found in manure and bedding. Environmental pathogens are the predominant cause of mastitis on dairy farms. Quarters can become infected with coliform bacteria once in contact with the organic matter hosting the pathogens. Once inside the quarter, coliform bacteria will multiply rapidly, causing inflammation of the quarter or quarters infected.

In some cows, coliform species, such as *E. coli*, can cause chronic or recurring infections. Coliform infections can cause damage to mammary cells, which could lead to the loss of function of the infected quarter. Coliform bacteria are associated with 50–70 percent of severe mastitis cases, with some cases entering the bloodstream, which could ultimately cause death of the animal.

A coliform vaccine can be effective in reducing the incidence of clinical mastitis and milk losses associated with the infections, and can help reduce the severity of the infection. The following vaccines are approved for use at dry-off to protect against *E. coli* and other coliforms that can cause mammary infections: ENVIRACOR J-5 (Zoetis US, Parsippany-Troy Hills, NJ), J-VAC (MERIAL, Duluth, GA), and ENDOVAC-Dairy (Endovac Animal Health, Columbia, MO). Please work with your veterinarian to evaluate which is best for your herd.

Take-Home Messages

One of the most important stages of a dairy cow's lactation is the dry period. If a cow does not have a long enough dry period, has an existing mammary infection at dry-off, or contracts a new mammary infection during this period, her upcoming lactation may be negatively affected. By using the best management practices described above, producers can provide their cows with an optimal dry period for them to reach their potential during the next lactation.

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