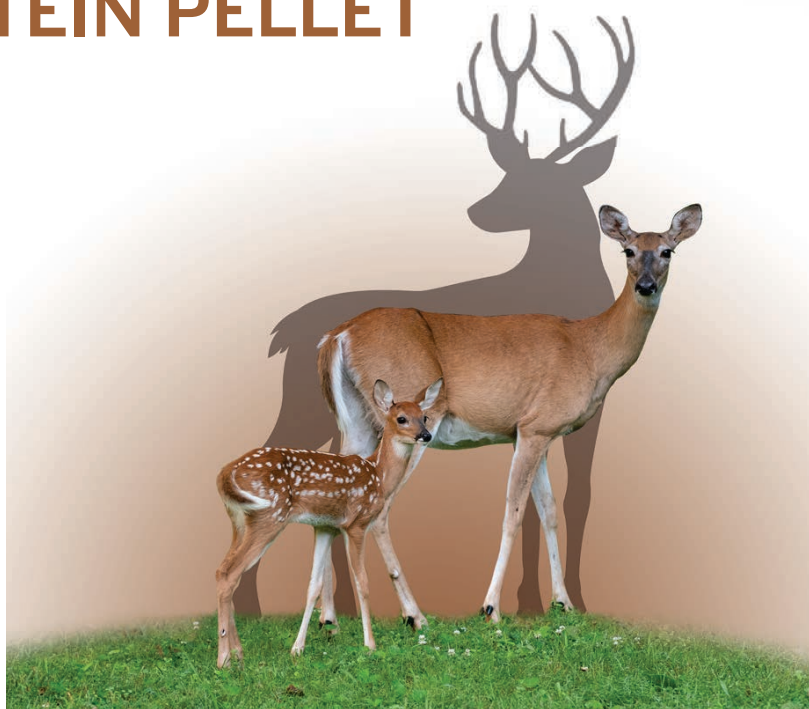


CRYSTAL CREEK® BABY BUCK® PROTEIN PELLET

Crystal Creek® is well known for their livestock nutrition products, but did you know we have options for wildlife too? Baby Buck® is an easy to feed, pelleted protein and mineral supplement for deer. Baby Buck® utilizes the science of epigenetics to give landowners a novel, effective way to provide a long-term management plan for producing a more vigorous deer population. Baby Buck® focuses on the nutritional needs of the pregnant doe to produce larger, healthier bucks. If you are looking for a proven, science-based method aimed at increasing antler size, body size and herd health within your local deer population, contact Crystal Creek® today.



Winter Livestock Care

Winter months can be difficult for livestock. Crystal Creek® is here to help with quality nutrition solutions that can better prepare animals for colder temperatures. The main goal of feeding during cooler weather is to maintain proper body condition. In pregnant animals, additional nutrition must be

provided for the growing fetus. Youngstock must be supplied with enough calories to not only stay warm, but to continue to grow. Contact Crystal Creek® today to ensure your livestock's diet has what is needed to perform basic functions as well as support good health and performance.



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Inoc-U-Lock™ : Preserving Forages And Protecting Your Hard Work



By Teresa Marker, B.S.

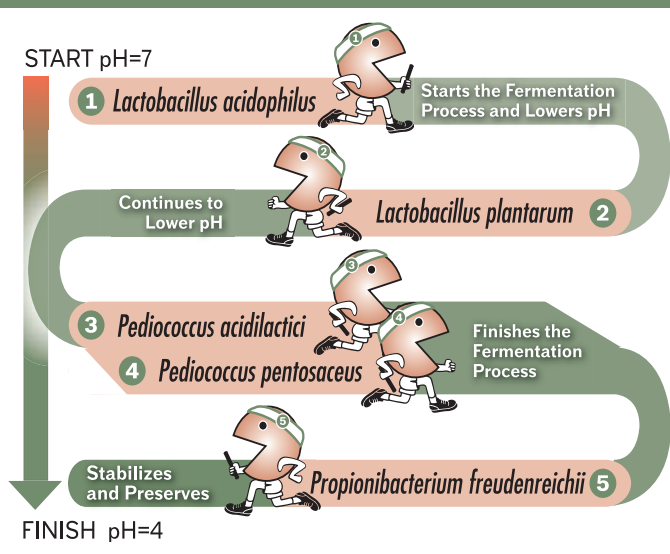
Feeding high-quality forage to livestock can help improve animal performance, health and producer profitability. Properly inoculating livestock feedstuffs with an inoculant that provides complete and controlled fermentation is key. The Crystal Creek® product Inoc-U-Lock™ provides many benefits such as reduced dry matter loss, improved nutrient retention (protein and energy) during storage, improved aerobic stability and a reduced risk of heating in the bunk. A properly fermented feed preserves the quality of the forage that is harvested and can ultimately result in increased milk production and improved animal health.

There are many inoculants on the market but not all inoculants are created equal. Many competitive products are not built to offer a complete fermentation process. Inoc-U-Lock™ uses a special, controlled fermentation technique, with a unique combination of specific bacteria and enzymes which drive the pH down in a fast, efficient manner so that both feed quality and dry matter are preserved. Each strain of bacteria in the Inoc-U-Lock™ products produce an acid: lactic, acetic or propionic.

Each specific bacteria group in Inoc-U-Lock™ works at an optimum pH range, driving the pH lower and lower. This controlled fermentation technique can be thought of as a relay race. As the pH of the forage is being reduced, another bacteria and associated enzyme will pick up the relay baton and continue to drive the pH down until the next bacteria takes over. The lower the pH, the better the fermentation of the feed. Properly fermented feed results in less spoilage during storage and feed out. The higher the level of good acids (lactic and acetic) the greater the likelihood will be that the feed is fermented properly resulting in a lower risk for the presence of detrimental acids (butyric) or wild yeast.

Figure 1

INOC-U-LOCK™ CONTAINS 5 TYPES OF BACTERIA

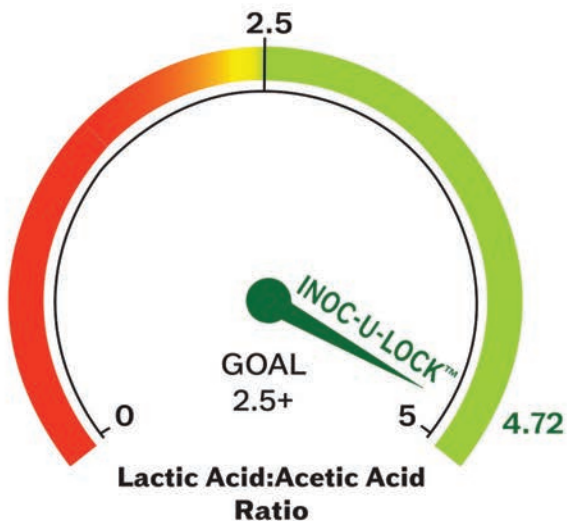
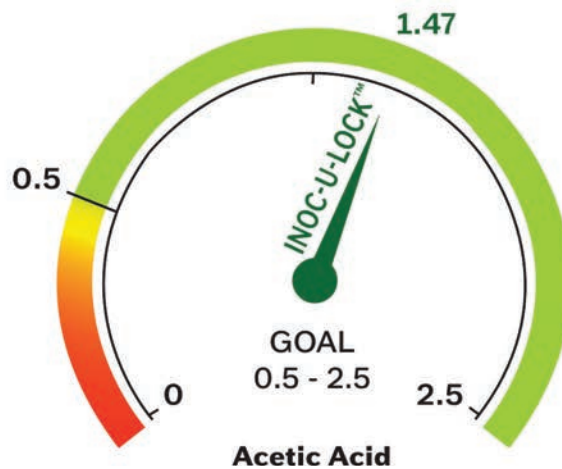
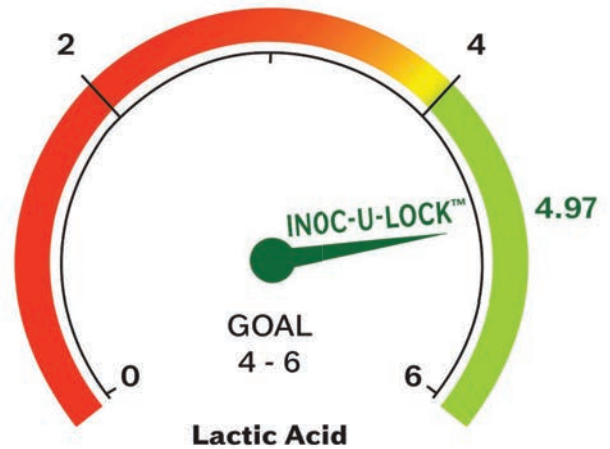
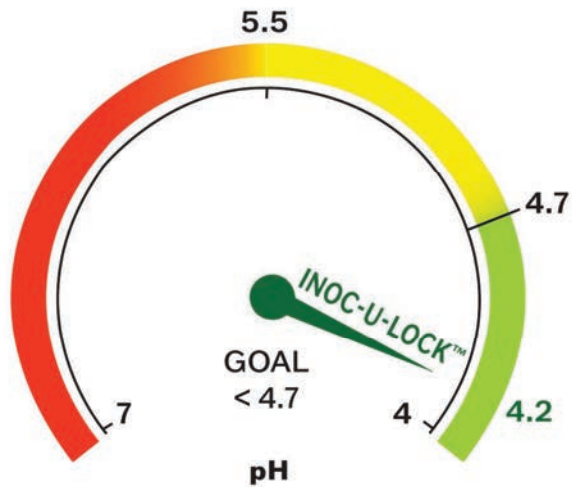


The diagrams on the following page show data obtained from haylage samples treated with Inoc-U-Lock™, along with the corresponding target fermentation goals from Dairyland Laboratories' website dairylandlabs.com. The diagrams show that haylage treated with Inoc-U-Lock™ reached all the recommended target levels for a properly fermented feed. The use of regular testing to obtain a fermentation profile of your feed can help determine if feed is fermented properly and help identify any risk factors the feed may have such as protein degradation and/or the presence of butyric acid.

The Inoc-U-Lock™ line of products are designed for use with many different applicators and can also be used for corn silage and high moisture shell corn (HMSC). Always refer to your applicator manual for proper directions. Inoc-U-Lock™ is available in water soluble and granular forms. The water soluble jar is 350 grams and will treat 100 ton of haylage. The granular form is available in a 25 lb. bag and will treat 50 ton of haylage. Call Crystal Creek® today to discuss the use of Inoc-U-Lock™ on your forages.

References available upon request.

Crystal Creek® Inoc-U-Lock™ Haylage Fermentation Results



Four Air Exchanges Per Hour: A History Of Calf Barn Ventilation And An Industry That Is Slow To Change



By Ryan Leiterman, D.V.M.
Director of Technical Services

When discussing calf barn ventilation, invariably the topic of using four air exchanges per hour for cold weather ventilation will come up. After all, we wouldn't want "too much" of that cold air in the barn. Or would we? Who came up with the idea to use four air exchanges

per hour during cold weather and why? To understand our industry's current ventilation recommendations, we must first understand the history of calf barn ventilation research.

Take a trip back in time. It's the late 1970's and Jimmy Carter is president. A new F-150 pickup truck sells for \$5,489 and US milk production averages 11,891 pounds per cow per lactation.

Over the winter of 1977, the University of Minnesota conducted a research trial evaluating calf respiratory health by comparing two different ventilation rates; one air exchange per hour vs four air exchanges per hour. One group of 40 Holstein bull calves received a ventilation rate of one air exchange per hour while another group of 40 Holstein bull calves received a ventilation rate of four air exchanges per hour. All other variables were kept constant between the groups of calves. At the end of the trial, calves from each group were euthanized and their lungs were examined. The study concluded that the calves raised with four air exchanges per hour had fewer cases of pneumonia when compared to calves raised with one air exchange per hour.

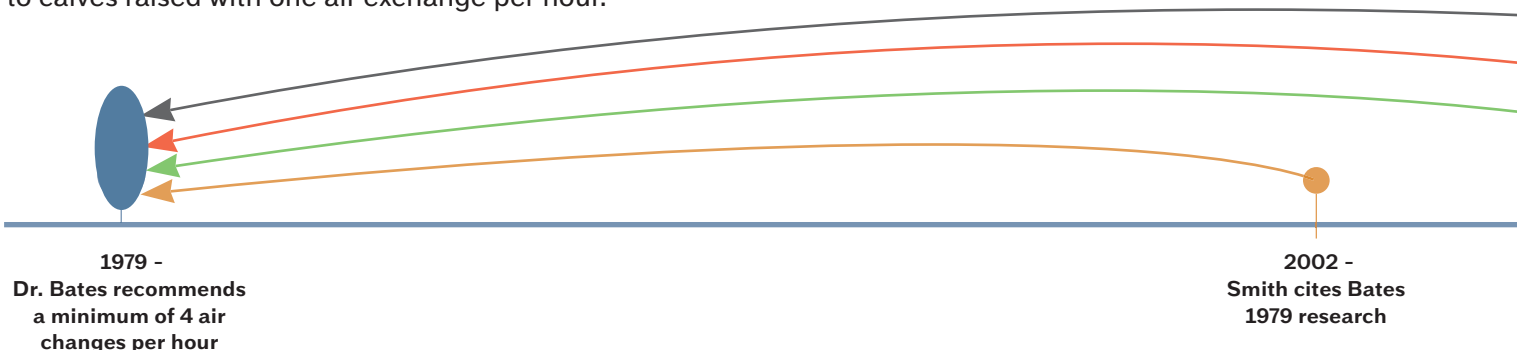
In 1979, Dr. Bates, a professor at the University of Minnesota published the 1977 trial results in a paper titled "*Calculation of Ventilation Needs for Confined Cattle*" in which he stated, "For air purity, the fundamental criterion in designing a calf barn ventilation system is to provide continuous exhaust at a minimal rate of about 4 air changes per hour. This will reduce aerosol contaminates in addition to controlling moisture."


Note that Dr. Bates refers to four air changes per hour as a **minimal** air exchange rate, suggesting that higher ventilation rates may be necessary.

Nearly every scholarly publication regarding calf barn ventilation in the past 20 years recommends four air changes per hour during cold weather, citing the paper of Dr. Bates in 1979. To date, peer reviewed research exploring cold weather ventilation rates greater than four air changes per hour has not been conducted.

In 2002, Dr. Bradford Smith released the third edition of "*Large Animal Internal Medicine*", where he states that mechanically ventilated barns should have a "fan capacity to achieve 4 air changes per hour in winter." and provides the paper written by Bates in 1979 as the citation for that recommendation.

In 2006, Dr. Lago published a paper titled "*Calf Respiratory Disease and Pen Microenvironments in Naturally Ventilated Calf Barns in Winter*", where he discussed the differing recommendations for minimal ventilation rates of calf barns and cites the 1979 paper of Dr. Bates.





“Dr. Bates arrived at the number of four air exchanges per hour empirically, which could also be described as an educated guess.”

- Dr. Leiterman

In 2007, Dr. Ken Nordlund published a paper titled *“Housing Factors to Optimize Respiratory Health of Calves in Naturally Ventilated Calf Barns in Winter”*, where he cites the 1979 work of Dr. Bates stating that cold weather ventilation systems should be used to “direct small volumes of fresh air into the pens.”

In 2008, Dr. Ken Nordlund published a paper titled *“Practical Considerations for Ventilating Calf Barns in Winter”*, where he cites the 1979 work of Dr. Bates, stating “Current recommendations for minimal winter ventilation rates in calf barns range from 15 cubic feet per minute to four air changes of the building per hour.”

In 2011, Ingrid Lorenz cites the 1979 work of Dr. Bates in a paper titled *“Calf Health from Birth to Weaning III. Housing and Management of Calf Pneumonia”*, where she states: “To prevent adverse conditions, at least 4 air changes per hour are needed in winter.”

Why is the dairy industry still using calf barn ventilation recommendations that are based on a single research trial done in 1977?

The simple answer is change happens slowly. The real reason for a lack of change has more to do with human nature than it does with ventilation technology. A population of people is comprised of five distinct groups and an idea or innovation must be widely adopted over time in order to self-sustain. The five groups are:

- 1) **Innovators:** Visionaries and inventors that develop new ideas.
- 2) **Early Adopters:** People who are first to try new ideas. They jump at new products, embrace change and love being the first in their social group to do something new.

(Continued on Page 6)

2006 -
Lago et al cites Bates
1979 research

2007 -
Nordlund cites
Bates 1979 research

2008 -
Nordlund cites Lago et al
2006 paper which cited
Bates 1979 research

2011 -
Lorenz cites Bates
1979 research

Four Air Exchanges Per Hour: A History Of Calf Barn Ventilation And An Industry That Is Slow To Change

(Continued From Page 5)

- 3) **Early Majority:** People who don't want to try something until their neighbors have tried it first.
- 4) **Late Majority:** People who don't want to try something new until the majority of other people are already doing it. These people want to be sure that it is a good idea. They do not love change but they are willing to adapt.
- 5) **Laggards:** People who are resistant to, or refuse, change.

Once an idea obtains acceptance from the Early Majority group it acts like a tipping point and the Late Majority and Laggards will soon follow until the idea or innovation is widely accepted. For change to happen, a new idea must go through the same process of acceptance throughout the population in order to replace the old idea. The idea of using four air exchanges per hour for winter ventilation has been with our industry for a long time. When it first came out, the innovator, Bates, faced challenges in getting his idea to take hold. Now that the Bates idea has gone through the various stages of acceptance, it has become widely adopted.

What's Next?

Before the dairy industry can advance the topic of calf barn ventilation forward, we must first realize that the recommendation of Bates in his 1979 paper was that four air exchanges per hour in the winter should be viewed as a minimum ventilation rate.

There is a common belief in the dairy industry that if we bring "too much" fresh air into the barn, it will create a draft on the calves; but this is not true. Using modern ventilation methods, it is quite easy to achieve higher ventilation rates without causing a draft. Furthermore, calves raised outdoors in hutches have significantly lower respiratory disease rates than their barn raised counterparts; showing us that in the absence of a draft, there is no such thing as "too much" fresh air.

Four air exchanges per hour has been proven to be better for calf health than one air exchange per

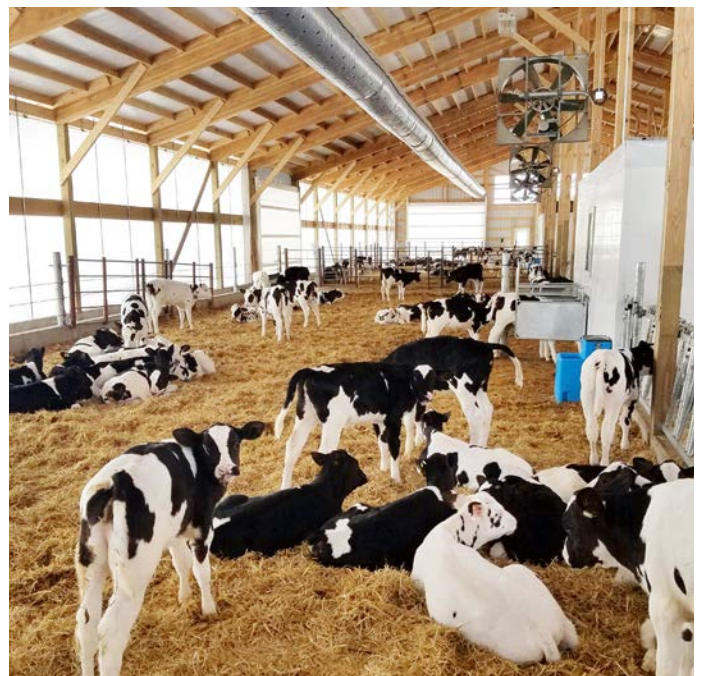
hour. So, shouldn't we as an industry be curious if six, eight or maybe even ten air exchanges per hour would be better than four? Some of the innovators and early adopters in our industry are already using winter ventilation rates greater than four air exchanges per hour and seeing positive results.

The industry needs new, innovative research that compares air quality and calf health with cold weather ventilation rates greater than four air changes per hour.

Numerous improvements in calf housing and welfare have been made over the last four decades but the industry still suffers from calfhoo pneumonia. Until the day comes that calves in barns have the same, or less, respiratory disease rates as calves housed in outdoor hutches, the work on improving calf barn ventilation is not finished.

The first step of change is innovation and innovation can only be driven by curiosity. We, as an industry, need to be curious and start to wonder if four air changes per hour is the best option for calves. New and updated research is needed.

References available upon request



Cold Weather Considerations For Calves

When temperatures start to drop, calf raisers need to make accommodations to ensure calves have the resources necessary to maintain their body temperature, support basic bodily functions and develop into productive, profitable, young stock. Two general areas to consider when preparing your calves for winter months are diet/nutrition and housing.

It is important to follow a consistent newborn calf protocol. Calves should be born in a clean, dry, well bedded calving pen. Newborns should be dried off and have their navels dipped within two hours of birth whenever possible. A 4-quart feeding of colostrum with a minimum Brix reading of 23% (or minimum of 200 IgG) should be fed within the first 4 hours of birth. Calves can be fitted with a calf jacket at this time and monitored for any sign of difficulty with feeding.

Diet/Nutrition

Calves need calories to grow. A calf's normal body temperature is 100.0-102.5° F and their (environmental) thermoneutral zone is between 50-78° F. For every 10° F drop in temperature below a calf's thermoneutral zone, their calorie needs increase by 10%. As more energy is being used to maintain body temperature, less energy is available for other areas such as immune support and growth.

While fat additives, or increasing the fat percentage in the milk replacer, does increase calories delivered to the calf, research has shown this strategy is not the best approach as it can reduce the calves' overall digestion efficacy. Feeding increased fat to calves in the winter will sacrifice calf performance. It is for this reason that Crystal Creek® recommends increasing the amount of milk, or milk replacer, fed rather than increasing fat content. Crystal Creek® Swift Start® cold processed milk replacer provides easily digested fats for more useable energy, as well as wheat isolates to help with rumination and 100% organic trace minerals and selenium that support immune function.

It is important to be consistent with milk feeding times, volumes, temperatures and total solid concentrations. Total solid values need to remain

between 12-14% to prevent nutritional scours. Adding more powder but not increasing the amount of water mixed with it will change the total solids concentration and can cause nutritional scours.

Water intake helps with hydration and supports body functions, but it also drives calf starter/feed intake to help promote rumen development. The additional calories from calf starter can help calves meet energy requirements while providing heat from rumination to help warm the body. Offering warm water three times/day for a minimum of 30 minutes can encourage water consumption. Feeding Crystal Creek® Swift Start® Texturized Calf Feed will provide quality protein sources to assist in digestibility and amino acids to support muscular/skeletal development while promoting daily rates of gain.

Housing/Ventilation

The main goal of any calf operation is to provide a clean, dry and comfortable environment for the calf. Whether housed in hutches or barns, calves will need adequate bedding and proper ventilation. A good rule of thumb is to provide 25 lb. of fresh, clean, long stem straw per 1,000 lb. of body weight every day. Calves should be able to nest down in the bedding, so their legs are not visible. Wheat straw is the preferred bedding substrate for calves in the winter.

Calves in hutches should have hutch openings face away from the wind while allowing the calf to lie where it can benefit from the sun. Hutch vents should provide adequate air circulation but not create drafts. Calves in barns need a ventilation system that provides a fresh air exchange even in cold weather. Proper ventilation should assist in the removal of noxious gasses, moisture and irritant particles from the air. Do not close-up calf facilities to try to limit cold air exposure. This, in fact, reduces the VOLUME of fresh air supplied to calves and increases the risk of environmental pneumonia through contaminated air.

Keeping calves warm, healthy and growing during cold winter months is possible with the right strategy. Contact Crystal Creek® today to learn more.

The Recovery Period: Tips For A Successful Dry Off



By Erik Brettingen, B.S.

The dry cow period is arguably the most important time in the cow's lactation cycle as it is the time in which the cow rests her body and prepares for the next lactation. The timing and way in which a cow is dried off can greatly impact how well

she will transition into the dry period and how well she will come into her next lactation. A properly managed dry off protocol should minimize the risk of mastitis, maximize cow comfort and allow for mammary tissue rest and recovery in preparation for the next lactation. There are many questions surrounding the topic of dry off including:

- 1) How important is the dry period?
- 2) What is the optimal length of time for a dry period?
- 3) What steps should be taken when drying cows off?

Importance Of The Dry Period

The dry cow period should not be thought of as the end of one lactation, but actually as the set up for the upcoming lactation. More than just the mammary tissue is rejuvenated during this time. With the stress of lactation removed, rumen health, hoof health and immunity can be strengthened.

Lactating rations have higher energy and starch levels, with lower fiber levels, than dry cow rations. While being fed a lactating diet, cows may develop sub-acute rumen acidosis at some point during their lactation. This acidotic state damages the rumen's lining, causing damage that has negative effects on the absorption of nutrients, which in turn affects overall animal health. A high fiber, low starch dry cow ration allows for the recovery of the ruminal wall, setting the cow up for maximum nutrient absorption and fiber digestion in the upcoming lactation.

Hoof health can suffer under the stress of lactation, leading to lameness and ultimately, decreased production. Many producers find that dry off is a great time to trim hooves. Trimming can remove areas of damage and fix the hoof to set it up for proper re-growth. The hoof face grows at a rate of 0.16 to 0.20 inches per month. The total sole surface is anywhere from 0.28 - 0.47 inches, meaning that after a 2 month (60 day) dry period, the entire sole is re-grown, recovered and ready for lactation. This re-growth and rebuilding strengthens the hoof, making the cow more mobile and more comfortable lying down and getting up, which in turn will increase feed intake, reduce risk of metabolic problems at freshening and increase profitability in the upcoming lactation.

A strong, healthy immune system starts with high quality nutrition. A well-balanced dry cow ration and a highly bioavailable mineral source are needed to maximize immune function and ensure optimum recovery in the dry period. Crystal Creek® Dry Cow Mineral is formulated with polysaccharide chelated trace minerals, 100% selenium yeast and strong vitamin fortification to support immune function and tissue recovery. These factors are crucial to not only decreasing the risk of infection, but also prepping the cow to be more profitable in her next lactation.

Crystal Pellets™ and Crystal Creek® Whole Leaf Aloe Vera Juice are two nutritional supplement products that contain aloe vera for a flavoring agent. The natural ingredients in these products have been scientifically proven to decrease inflammation, stimulate the immune system along the gastrointestinal tract, promote nutrient absorption in the lower gastrointestinal tract and promote antioxidant regeneration. Crystal Pellets™ are a very powerful tool in assisting the immune system to prevent infections at the beginning of the dry period and can also be fed the last two to three weeks of the dry period to boost immune function at the time of calving.

Figure 1**PROCESS OF MAMMARY TISSUE RECOVERY**

Milk Component	Active Involution	Steady State Involution	Redevelopment and Colostrum Production
Lactose	Decreasing	Low	Increasing (late)
Milk Proteins	Decreasing	Low	Increasing
Milk Fat	Decreasing	Low	Increasing
Pathogen Protection Factors			
Leukocytes (Disease Fighting White Blood Cells)	Increasing	High	Low
Lactoferrin (Iron Binding Glycoprotein)	Increasing	High	Low
Immunoglobulin (Antibody Protein)	Increasing	High	Increasing

Vaccines can be used during the dry cow period to help prevent disease and enhance immune related responses. Many vaccines used in dry cows have double benefits. Using a vaccine not only improves the cow's immune system, but can increase the levels of antibodies in the colostrum to be passed on to the cow's newborn calf. Producers are encouraged to work with their herd veterinarian to determine which dry cow vaccines are needed in their operation and when those vaccines should be given.

The rejuvenation of mammary tissue can be broken down into three distinct phases (**Figure 1**). Active involution, steady state, and redevelopment/generation of colostrum. In the active involution stage, the udder is shutting down milk production and ramping up pathogen protection. The steady stage keeps things consistent, continues to protect the mammary tissue from infection and prepares for the transition into lactation. The third and final stage of the dry period is when the cow begins to work towards producing milk again. Energy is diverted to focus on fat, protein, and fluid volume while pathogen protection will begin to weaken.

Length Of Dry Period

While there is some debate on what the ideal length is for the dry period, it is agreed that a minimum of 45 days should be required. Dry cow periods that are less than 40 days, or greater than 80 days, have been shown to decrease milk production in subsequent lactations. Crystal Creek® recommends a 60-day dry cow period. A 60-day dry cow period is long enough to provide the time needed for recovery, but returns cows to the milking herd, in a timely manner, where they are generating revenue again. Studies show that cows given at least 60 days for a dry period, produce on average, 249 pounds more milk in the next lactation.

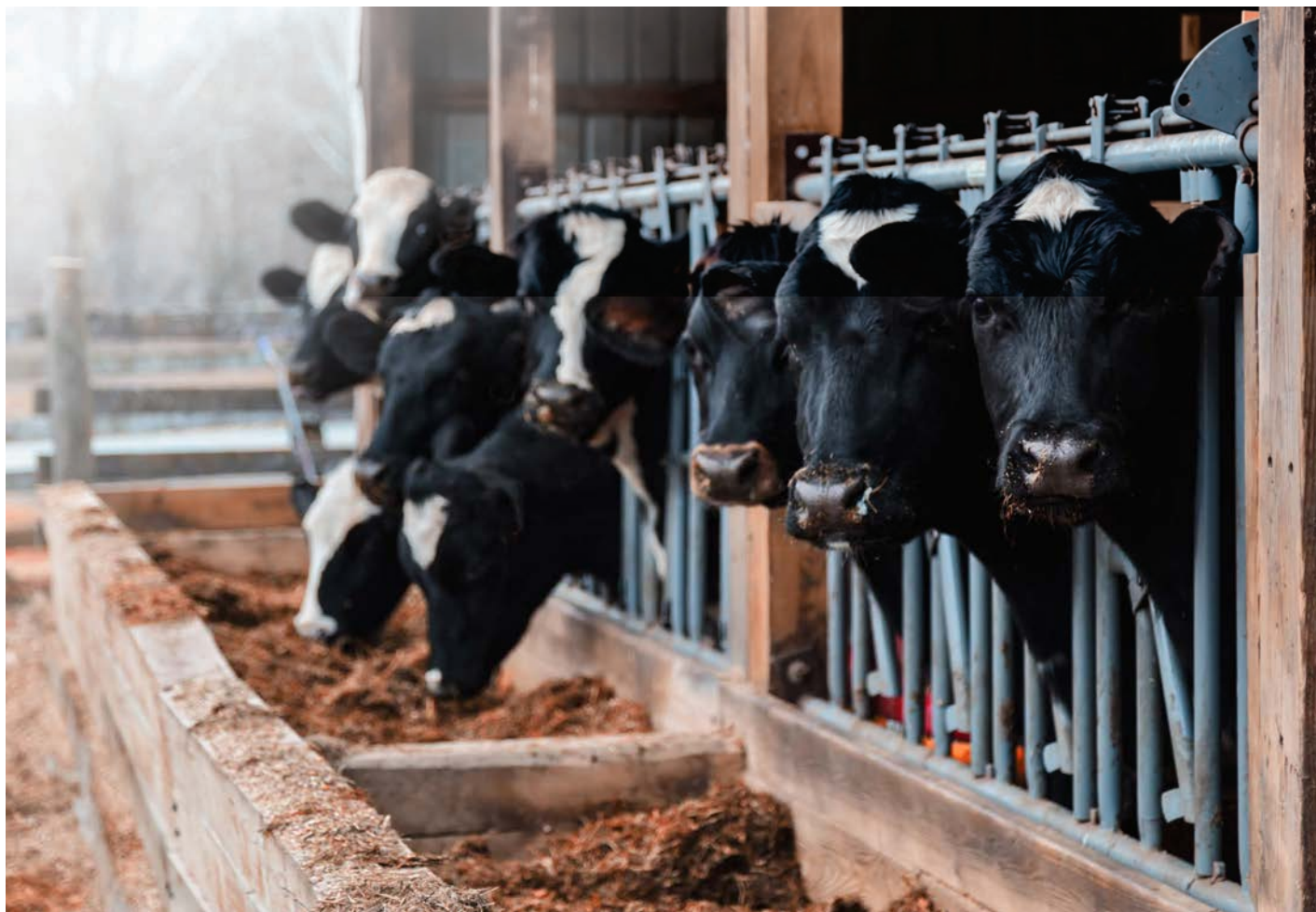
Steps For A Successful Dry Off

Cows that are still producing large volumes of milk at dry off are at an increased risk of developing mastitis in the dry period. These cows will use their white blood cells to absorb and get rid of milk fat cells rather than using them to defend against

(Continued on Page 10)

The Recovery Period: Tips For A Successful Dry Off

(Continued From Page 9)



bacterial infections. They also do not produce a protective keratin plug in the teat canal. Keratin, which is a fibrous protein, forms a barrier in the teat canal that impedes bacteria from entering. If large volumes of milk are being produced and leaking out of the udder, this keratin barrier is never formed. This, coupled with the lack of active white blood cells, greatly increases the risk of an infection developing.

The best way to decrease milk yield is to limit the intake of high quality, high energy feeds in the lactating diet. Typically, all grain is removed from the diet one to two weeks prior to the start of the dry cow period. The introduction of lower quality, fibrous, grassy hay can also help lower energy concentrations. Limiting water intake is highly effective in decreasing milk production in the last few days before the planned dry off date. While there is some debate about

decreasing the frequency of milking, most sources agree, using an abrupt dry off is best to cease milk production while preventing infections. Any stimulus that would encourage milk production during dry off should be avoided.

The way in which cows are dried off, the length of the dry cow period, and how cows are fed and handled while they are dry, all have a significant impact on cow health and productivity. Cows that are allowed adequate time to rest and rebuild will be more productive animals. Cows that are transitioned into the dry period in a manner that limits exposure to pathogens will freshen in as more profitable cows for the farm. To learn more about dry off strategies, call 1-888-376-6777 to talk with one of our knowledgeable staff.

References available upon request.

- BRIGHT START™
- SUPER BOOST™
CALF CAPSULES
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- CHECK™ CALF
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- POWER POWDER™
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\$10/bag discount
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Maximizing Equine Reproductive Performance: The Impact Of Biosecurity And Disinfection



By Alex Austin, B.S.

The goal of any biosecurity protocol should be to reduce the frequency and severity of disease. Equine infectious diseases can cause health and performance issues, increased treatment expense and potential

risks to human health. Horse owners with breeding facilities are encouraged to refer to the American Association of Equine Practitioners' guidelines for in-depth information on equine disease prevention and control. Equine reproductive infections can be costly; resulting in abortions, re-breedings and chronic reproductive issues where mares may not settle or stallions spread disease from farm to farm.

This article will discuss three areas horse owners can focus on to decrease the risk of disease transmission: 1) biosecurity protocol development 2) vaccinations and disease testing options and 3) cleaning and disinfection protocols.

Biosecurity Protocols

Each farm will have its own unique biosecurity protocol. Written protocols should be posted in an area that is visible to all farm employees and visitors. It can be helpful to consult with a local veterinarian to assess the risk of specific conditions and to prioritize control measures. When horses are transported, there is a danger of introducing new pathogens to the home farm environment upon their return. Horses traveling off the farm, or that are new to a facility, should be quarantined for three weeks upon arrival/return (10 days at the very minimum). Stables with high traffic, both equine and human, should consider having a separate barn for breeding horses to create a more controlled environment.

People can act as vectors in spreading pathogens from horse-to-horse or farm-to-farm. Three simple measures that can be implemented are:

- 1) Provide handwashing stations around the facility and alcohol-based hand sanitizer containers where handwashing is not possible.
- 2) Require employees and boarders to wear dedicated boots and clothing to the stable and have visitors wear boot covers. Limit direct contact between visitors and horses.
- 3) Keep each horse's equipment separate. This includes water and feed containers, tack, and grooming equipment. Clean and disinfect any shared stall cleaning equipment such as forks and shovels.

Understanding Reproductive Diseases: Vaccinations And Testing

Most discussion regarding pathogens involved in equine reproduction is centered around venereal transmitted diseases. Many of these diseases have diagnostic tests that can be performed on mares and stallions prior to breeding. Pathogens can have multiple negative impacts on a horse; beyond reproductive repercussions. Each horse may react differently to an exposure. For example, equine herpesvirus (EHV) can cause respiratory, neurological, and/or reproductive issues. EHV comes in many different forms and can be spread by direct contact with nasal secretions (horse to horse) or indirect contact (contaminated water buckets, trailers, tack and even human hands and clothing). The incidence of EHV transmission can be reduced with good biosecurity and disinfection practices.

When dealing with equine venereal diseases, some diseases require direct contact, others can



be transmitted via contaminated semen, collection/storage equipment, pastures/stalls and the personnel involved in the breeding process. Standard protocols during breeding practices include wrapping of the mare's tail, thoroughly cleansing the stallion and mare's reproductive areas, using disposable gloves that are changed between animals and complete cleaning and disinfecting of all equipment involved in the procedure. The economic impact of a venereal disease spreading in a breeding facility can be devastating.

Preventative measures such as testing, vaccinating and physical exams can help prevent the spread of many equine diseases. Utilizing diagnostic testing for viruses and bacterial infections in mares and stallions

can significantly decrease exposure and transmission rates. Requiring a Certificate of Veterinary Inspection (CVI), a negative Coggins Test (EIA) and completion of core equine vaccines are common requests from most breeding facilities. Core vaccine programs can vary based off location, risk of disease and the anticipated effectiveness of vaccine. Core vaccines usually include a Rabies, Tetanus, Eastern/Western/Venezuelan Encephalitis and West Nile vaccine. Facilities may have additional requirements such as negative bacterial cultures from the mare and/or stallion within 48 hours prior to breeding and proof of tests for *T. equigenitalis/asinigenitali* (the causative agents of contagious equine metritis).

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Cleaning And Disinfection Protocols

Even with the best biosecurity protocols and vaccination plans, harmful pathogens can still exist in the horse's environment. This is where a good cleaning and disinfection protocol comes into play. Just because a surface looks visibly clean does not mean it is biologically clean. Removing the gross debris from an area only cleans the surface, it does not disinfect. Without disinfection, the potential threat of exposure to bacteria, viruses and other organisms is still present to the horse. Over time, pathogens will build into self-protective layers known as biofilms.

Biofilms are defined as thin, slimy films of bacteria, protozoa and viruses adhered to a surface in a resistant matrix of cellular material. As the biofilm grows, it will begin to secrete an extracellular layer of proteins and polysaccharides, which protect the pathogens within the layers from harsh environments and shield them from the action of most cleaners and disinfectants. Destroying the biofilm layer is the most important part of any cleaning and disinfection protocol.

Chlorinated Alkaline Detergents And Chlorine Dioxide: The Best Combination For Complete Disinfection

The first step in any disinfection protocol is choosing the correct disinfectant agents. They must be safe, effective and economical. If the chosen disinfectant does not affect biofilms, it will not be able to truly disinfect the environment. For many years, bleach was thought to be the best disinfectant of choice. Unfortunately, bleach has several major downfalls, with the most important point being that it does not attack biofilm layers.

New research has shown chlorine dioxide to be a more effective option than bleach as it has shorter contact times, lower corrosion potential and a



broader spectrum of efficacy against pathogens. Figure 1 shows chlorine dioxide as the product of choice when dealing with a variety of pathogens. To learn more about chlorine dioxide and biofilms, see the article "Understanding Biofilms In Agriculture" in the April 2019, Crystal Creek® newsletter.

Disinfection Of Surfaces

A widely adopted cleaning protocol generally consists of three main steps:

- 1) Clean the surface of gross visible debris.
- 2) Apply a foaming chlorinated alkaline detergent to the surface, allowing for 10-15 minutes of contact time to dissolve the biofilm layer and then rinse.
- 3) Apply a 50 to 100 ppm chlorine dioxide spray to disinfect the surface, allowing the surface to dry.

Figure 1

COMPARISON COMPONENT	OZONE (O ₃)	HYDROGEN PEROXIDE (H ₂ O ₂)	PERACETIC ACID (POA)	HYPOCHLOROUS ACID (HOCl)	SODIUM HYPOCHLORITE (NaClO)	CHLORINE (Cl ₂)	CHLORINE DIOXIDE (ClO ₂)	QUARTERNARY AMMONIA	PHENOLS	IODOPHOR
E. COLI	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
GIARDIA	YES	NO	NO	NO	NO	NO	YES	NO	NO	NO
CRYPTOSPORIDIUM SPP	YES	NO	NO	NO	NO	NO	YES	NO	NO	NO
ROTAVIRUS	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
CORONAVIRUS	YES	YES	YES	YES	YES	YES	YES	NO	NO	NO
PEDv	YES	YES	YES	YES	YES	YES	YES	NO	NO	NO
BIOFILM REMOVAL	YES	VARIES	VARIES	NO	NO	NO	YES	NO	NO	NO
AFFECTED BY pH	NO	YES	YES	YES	YES	YES	NO	YES	YES	YES
CORROSIVE	YES	YES	YES	YES	YES	YES	NO	VARIES	YES	YES
INACTIVATED BY ORGANICS	NO	YES	YES	YES	YES	YES	NO	NO	NO	YES
WATER SANITIZER / DISINFECTANT	NO	NO	NO	NO	YES	YES	YES	NO	NO	NO
EPA APPROVED WATER SANITIZER	NO	NO	NO	NO	YES	YES	YES	NO	NO	NO
USED WITH DETERGENTS	NO	NO	YES	NO	YES	NO	YES	YES	YES	YES
PRODUCED ON-SITE	YES	RARELY	RARELY	RARELY	YES	NO	YES	NO	NO	NO

The combination of chlorinated alkaline detergent foam spray followed by a chlorine dioxide surface treatment creates a highly effective disinfection protocol; even against pathogens that are hard to kill. It can be used for disinfectant purposes all around the farm such as housing/stalls, feeding equipment, trailers and as a disinfectant rinse or spray for commonly touched surfaces. For more detailed instructions on disinfection protocols, see the article “*Hygiene Protocol For Successful Calf Raising*” in the April 2017, Crystal Creek® newsletter.

Disinfection Of Waterers

Keeping water sources clean is a challenge on many farms. Studies have shown that the continual use of chlorine dioxide can be an effective method of not only sanitizing the water, but in breaking down the biofilm layers that attach to water container surfaces and preventing the re-growth of those biofilms. The

World Health Organization gives guidelines on the use and safety of chlorine dioxide in drinking water. Taste and odor threshold for chlorine dioxide are listed at approximately 0.2-0.4 ppm. Continual use of chlorine dioxide in equine water sources maintained at 0.4 ppm will help to prevent biofilm growth. It can be used for both stock tanks and water cups.

Implementing a successful and easy to follow biosecurity protocol can help keep your equine breeding facility secure. Biosecurity and disinfection measures have a direct impact on horse health, performance and facility profitability. Contact Crystal Creek® to learn more about using chlorine dioxide in equine water sources and how a biosecurity and equine disinfection program can help keep your equine facility safe.

References available upon request.



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