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From the National Mastitis Council

A Practical Look at Contagious Mastitis and Dry Cow Therapy

Schering-Plough

Brought to You Courtesy of Schering-Plough Animal Health

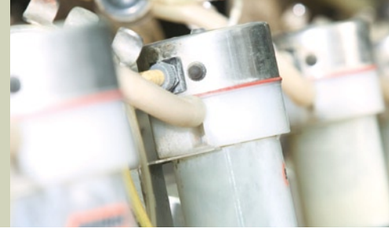
Contagious Mastitis

A Practical Look at Contagious Mastitis

Introduction

Pathogenic microorganisms that most frequently cause mastitis can be divided into two groups based on their source: environmental pathogens and contagious pathogens. The major contagious pathogens are *Streptococcus agalactiae*, *Staphylococcus aureus*, and *Mycoplasma* species. With the exception of some mycoplasmal infections that may originate in other body sites and spread systemically, these three organisms gain entrance into the mammary gland through the teat canal. Contagious organisms are well adapted to survival and growth in the mammary gland and frequently cause infections lasting weeks, months or years. The infected gland is the main source of these organisms in a dairy herd, and transmission of contagious pathogens to uninfected quarters and cows occurs mainly during milking time. This fact sheet will describe the characteristics of the major contagious intramammary infections, management efforts and specific control procedures to reduce new infection rates with these organisms, and a step-by-step control program for contagious mastitis.

Contagious organisms are well adapted to survival and growth in the mammary gland and frequently cause infections lasting weeks, months or years.



Mastitis caused by Strep. agalactiae should be suspected in a herd if cow or bulk tank SCCs rise and remain high.

Organisms

Streptococcus agalactiae

Streptococcus agalactiae is a common mastitis agent whose eradication from individual herds is practical and cost-effective. Most infected cows show few clinical signs of mastitis, such as abnormal milk, but usually have high somatic cell counts (SCC). A decrease in milk production almost always accompanies infection. Mastitis caused by *Strep. agalactiae* should be suspected in a herd if cow or bulk tank SCCs begin to rise and remain high, especially when bulk milk SCC is 1,000,000 cells/mL or higher. Occasionally, high bacteria counts in bulk tank milk will occur when infected udders shed high numbers of *Strep. agalactiae* in the milk.

Streptococcus agalactiae primarily infects the cisterns and the ductal system of the mammary gland. An irritant is produced, causing inflammation of the gland which is mostly subclinical with occasional clinical symptoms. Accumulation of bacterial waste products intensifies the inflammatory response, resulting in destruction of milk-producing tissue and reduced milk yield or agalactia. *Streptococcus agalactiae* rarely causes severe illness, but extensive scarring of a quarter may render it unproductive in subsequent lactations.

Infected udders are the most important source of infection.

Staphylococcus aureus

Staphylococcus aureus is more difficult to eradicate than *Strep. agalactiae*, but definitely controllable. Infected udders are the most important source of infection. The organism readily colonizes teat skin lesions and the teat canal, and eventually passes into the mammary gland. The organism may also survive at other sites on the cow. Mastitis caused by *Staph. aureus* produces more damage to milk-producing tissues than *Strep. agalactiae* and decreases milk production, with reported losses of 45% per quarter and 15% per infected cow. Recurring signs of mild clinical mastitis often causes additional losses. High bacteria counts in bulk milk are generally not seen with *Staph. aureus* mastitis. However, as the number of infected cows increases, the bulk milk SCC increases, resulting in decreased milk quality. Herds with bulk tank milk SCC greater than 300,000 to 500,000 cells/mL often have a high prevalence of *Staph. aureus* infected quarters. The bacteria damage the duct system and establish deep-seated pockets of infection in the milk-secreting tissues, followed by abscess formation and walling-off of bacteria by scar tissue. This walling-off phenomenon is partially responsible for poor cure rates of *Staph. aureus* infections by antibiotic therapy. During the early stages of infection, damage is minimal and reversible. However, abscesses may release staphylococci to start the infection process in other areas of the gland with further abscess formation and irreversible tissue damage. Occasionally, infection by *Staph. aureus* may result in peracute mastitis with gangrene. This gangrenous mastitis is characterized by a patchy blue discoloration and coldness of the affected tissue.

Mycoplasma species

Mycoplasma species are highly contagious organisms, are less common than *Strep. agalactiae* and *Staph. aureus*, and are generally diagnosed in herds experiencing outbreaks of clinical mastitis that resist therapy. Frequently, the history of affected herds includes the recent introduction of new animals, a previous outbreak of respiratory disease, and/or cattle with swollen joints. Cows of all ages and at any stage of lactation are susceptible, but animals in early lactation seem to suffer more severely because of the occurrence of increased mammary gland edema. *Mycoplasma* spp. should be suspected in herds when multiple cows have clinical mastitis in more than one quarter but continue to eat and have little evidence of systemic disease. Cases are unresponsive to treatment, and generally affected cows show a marked drop in the milk production or cease lactating. However, *Mycoplasma* spp. may be isolated from high-producing cows in herds that do not experience the classic signs. Subclinical cases with intermittent signs of clinical mastitis are not uncommon. Infected cows may have a high SCC and shed organisms for variable periods. *Mycoplasma* spp. may damage the secretory tissue and produce fibrosis in the udder as well as abscesses with thick fibrous walls, and great enlargement of the supramammary lymph nodes.

Mycoplasma species are generally diagnosed in herds experiencing outbreaks of clinical mastitis that resist therapy.

Transmission of pathogens that cause contagious mastitis generally occurs at millking time.

Management Programs

Transmission of pathogens that cause contagious mastitis from infected cows to uninfected herdmates most generally occurs at milking time. Management factors important in transmitting contagious pathogens include the milking machine, milkers' hands, teat washing materials and treatment procedures. Spread of contagious pathogens can be greatly reduced by good udder hygiene and post-milking teat dipping.

Other management factors which may influence susceptibility to mastitis pathogens including those that cause contagious mastitis are:

Injury. Healthy teat skin is the first line of defense against mastitis. Lesions on teat skin frequently harbor bacteria that may cause mastitis. The cause of teat injuries should be quickly identified and eliminated. In cold climates, frostbite and chapped teat skin constitute injury and such injuries have been shown to harbor *Staph. aureus*.

Nutrition. Soils in many parts of the United States are deficient in selenium, and feedstuffs grown on these soils will be deficient. Also, the Vitamin A and E content of ensiled forages decreases during storage. Research indicates that diets deficient in Vitamins A, F or the trace minerals selenium and copper can lead to increased incidence of mastitis.

Milking system. Machine milking can also influence the rate of new contagious mastitis infection:

a) *The role of machines as a carrier of bacteria to uninfected cows can be minimized by segregating and milking cows with known infection or those with high SCC last.*

b) Bacteria can be transferred during milking from the infected quarter across the claw-piece to an uninfected quarter of the same cow. Cross infections may account for up to 40% of new infections in some herds. Properly designed and functioning milking equipment will prevent movement of air and milk droplets from one quarter to another, and may reduce these infections.

c) Abrupt reduction in milking vacuum can cause movement of air toward the tent end, and droplets of milk may strike the tent end (impacts). If the droplets are contaminated with bacteria, the impact may force bacteria into the teat duct and may increase the rate of new infection. Research has shown that high new infection rates were associated with vacuum fluctuations only when accompanied by liner slip, a condition known to generate teat end impacts.

d) Although it has been difficult to show experimentally that the milking machine can damage the teat end sufficiently to increase the chance of infection, machine operators must always be aware of this possibility.

Cross infections may account for up to 40% of new infections in some herds.

Good milking procedures help reduce the spread of infection from infected to uninfected cows.

Control Procedures

Contagious organisms, for which the primary source is the mammary gland of the cow, are transferred primarily by events associated with milking. Good milking procedures, including cleaning and sanitizing teats before milking and post-milking teat dipping, help reduce the spread of infection from infected to uninfected cows. In *Mycoplasma*-infected herds, the use of rubber or plastic gloves when milking is recommended. Ideally, gloved hands should be disinfected between cows and dried off with paper towels. Some research trials have indicated additional control of contagious pathogens by automated disinfection of teat cup clusters (backflushing) or dipping teat clusters in disinfectant between cows. However, this practice in the field has minimal effect in reducing the rate of new infection, especially when compared to what can be achieved when an effective post-milking teat dip is used properly.

Streptococcus agalactiae *can be controlled by treating infected udders with an appropriate intrammary infusion product.*

Streptococcus agalactiae

Streptococcus agalactiae is an obligate parasite of the mammary gland, which means that, in nature, it can only live and reproduce in the gland. Because of this host-parasite relationship, *Strep. agalactiae* can be controlled and eradicated from a herd by identifying and treating infected animals. This can be done by obtaining milk samples for microbiological culture from all cows in the herd, and by treating the *Strep. agalactiae* infected udders with an appropriate intramammary infusion product. *Streptococcus agalactiae* infection responds well to beta-lactam intramammary mastitis preparations in both lactating and dry cows. Using other classes of antibiotics often results in poor cure rates. Some chronic infections do not recover. If two regimens of treatment do not eliminate the infection, culling should be considered to prevent infecting other cows.

Once *Strep. agalactiae* has been eliminated from a herd, careful control measures should be maintained to prevent re-infection, including monitoring bulk tank milk by monthly cultures for at least 6 months to assure clearance of infections. A closed herd is required to maintain it free from this pathogen. Breakdowns frequently happen due to the purchase of infected animals or by using contaminated milking equipment at fairs or livestock shows. New arrivals should be sampled before joining the milking herd. Dry cows and heifers also need to be included in *Strep. agalactiae* eradication programs, since they can represent a source of re-introduction of the organism to the milking herd. Calves fed discarded milk containing *Strep. agalactiae* can spread the infection by suckling themselves or other penmates. Once *Strep. agalactiae* is established within the immature gland, it can persist until first parturition many months later. Therefore, dry cows and heifers should be cultured at calving before joining the milking herd.

Staphylococcus aureus

Staphylococcus aureus commonly produces long-lasting infections that can persist through the lactation and into subsequent lactations. To prevent *Staph. aureus* intramammary infections, it is necessary to limit the spread of this organism from cow to cow and to reduce to a minimum the number of infected cows in a herd. To attain these objectives, milk from infected cows should never come in contact with uninfected cows. *Staphylococcus aureus*-infected cows should be identified and milked last, or milked with a separate unit from those used on uninfected cows. Clinical mastitis sometimes occurs following prolonged subclinical infections. Antibiotic therapy during lactation may improve the clinical condition but usually does not eliminate infection. Infected quarters that do not respond to a single regimen of therapy are generally unresponsive to additional lactation treatment, regardless of culture and antimicrobial sensitivity tests. Dry cow therapy may give better results than treatment during lactation, but even then, chronic infections can persist into subsequent lactations. *Staphylococcus aureus* infection status of cows should be one of the considerations when culling decisions are made.

Dry cows and heifers need to be included in **Strep. agalactiae** *eradication programs.*

Milk from infected cows should never come in contact with uninfected cows.

Every infected cow should be identified and all uninfected cows closely monitored.

Maintaining a *Staph. aureus*-free herd is possible but more difficult than maintaining a *Strep. agalactiae*-free herd, and *Staph. aureus* may reappear even in a closed herd. To achieve a "*Staph. aureus*-free" status, every infected cow must be identified and handled as described in the preceding paragraph. The "uninfected" herd should be closely monitored by individual SCC and milk culturing. Teat injuries and chapped teat skin during cold weather should be minimized because they predispose cows to *Staph. aureus* intramammary infections.

Staphylococcus aureus has also been implicated in intramammary infections in calves, breeding age heifers, and heifers at calving. The source of the *Staph. aureus* to infect these young animals is not known but may be contaminated bedding, feeding milk from *Staph. aureus* infected cows, cross suckling, or exposure to high fly populations. Pregnant heifers should not be housed together with dry cows, when a significant number of cows in the herd are known to be infected with *Staph. aureus*.

Improper intramammary treatment of lactating or dry cows provides a good opportunity for spreading mycoplasmal infection.

Mycoplasma species

There is no effective treatment for mycoplasmal mastitis, but the disease can be controlled by identifying infected animals by sampling and culturing milk samples from all cows in the herd, followed by segregation and/or culling the infected animals. If *Mycoplasma* spp.-infected cows remain in the herd, they should be milked last or with a separate unit from those used on uninfected cows. Improper intramammary treatment of lactating or dry cows for other mastitis pathogens provides a good opportunity for spreading mycoplasmal infection from cow to cow, and even from herd to herd. Rigid sanitary precautions must be followed including the use of only single-use commercial treatment products. Multi-dose vials and intramammary infusion products have been implicated in herd outbreaks of mycoplasmal mastitis.

Great care should be used when purchasing replacements. Many herds become newly infected by adding cows with *Mycoplasma* spp.-infected udders. Before commingling with the herd, milk should be cultured from all replacement cows and heifers at calving for *Mycoplasma* spp. as well as for *Strep. agalactiae* and *Staph. aureus*. When herds are purchased, it is a good policy to culture all suspected mastitic cows as well as bulk tank milk.

Sometimes, the disease may suddenly appear in previously uninfected herds without the introduction of replacements. *Mycoplasma* is widely found as a resident of the bovine respiratory tract of apparently normal cows, and transfer of the microorganisms from the lungs to the mammary gland can occur. Mycoplasmal mastitis outbreaks have been associated with respiratory problems in calves, heifers and cows in poorly ventilated barns. Young calves fed milk from cows with *Mycoplasma* spp.-infected mammary glands are prone to have respiratory infections, which may persist for several months.

A herd suspected of having mycoplasmal mastitis should be cultured.

A herd suspected of having mycoplasmal mastitis, based on history and clinical signs, should be cultured in order to establish the nature of the infection. Mycoplasmal infections may be complicated by common bacterial infections which occur concurrently.

Employ proper preventive methods and develop effective mastitis treatment protocols.

Summary – Controlling Contagious Mastitis

1. Prepare teats properly prior to milking. Udders should be dry, and teats should be cleaned and dried prior to machine attachment, using single-service paper towels or individual cloth towels which have been laundered and dried after each milking.

2. Use adequately sized, properly functioning milking equipment. Use milking machines in a proper manner on properly prepared cows. Avoid unnecessary air admission into the teat cups during unit attachment, machine stripping and unit take-off that can cause irregular vacuum fluctuations.

3. Disinfect teats. Use an effective product after every milking. Post-milking teat disinfection is the single most effective practice to reduce the rate of new intramammary infection by contagious pathogens.

4. Assess clinical cases for treatment decisions. Most cases of clinical mastitis other than those caused by *Strep. agalactiae*, are only minimally affected by antibiotic therapy during lactation. Work together with the herd veterinarian to design a management protocol for mild, moderate, and severe cases of clinical mastitis.

5. Use dry cow therapy. Treat each quarter of every cow at drying off with a single dose of a commercially formulated, FDA-approved dry cow treatment product.

6. Consider culling chronically infected cows. Cows that are infected with *Strep. agalactiae, Staph. aureus* or *Mycoplasma* spp. present a risk to noninfected cows in the herd.

7. Maintain a closed herd. If new animals are purchased, culture milk from them before adding them to the herd.

8. Establish an active milk quality program with the herd veterinarian. Achievable goals for controlling contagious mastitis include: 0% cows infected with *Strep. agalactiae* and *Mycoplasma* spp.; and less than 5% of cows infected with *Staph. aureus*.

Dry Cow Therapy

Dry Cow Therapy

Role of Dry Cow Therapy

Dry cow therapy has traditionally been the use of intramammary antibiotic therapy immediately after the last milking of lactation. If products have a medicinal purpose or claim, they require approval by the appropriate regulatory authority [Food and Drug Administration (FDA) in the US and European Medicines Evaluation Agency (EMEA) in Europe]. Approved products applied by intramammary infusion at drying off can decrease the number of existing intramammary infections and/or prevent new infections during the early weeks of the dry period.

Intramammary infusion at drying off can decrease and/or prevent infection.

Use of dry cow treatment is one component of an effective mastitis control program that should also include: proper milking procedures using properly functioning milking equipment, dipping teats immediately after milking with a product known to be safe and effective, good udder hygiene between milkings, keeping accurate records of clinical mastitis and somatic cell counts on individual cows to assist in making management decisions, treating all clinical cases of mastitis promptly and appropriately, and culling cows with chronic mastitis.

Dry cow therapy is effective for treating existing infections and preventing new infections.

Curing Existing Infections

The most effective time to treat subclinical udder infections is at drying off. Dry cow therapy has the following advantages over lactation therapy:

a) The cure rate is higher than that achieved by treatment during lactation, particularly for *Staphylococcus aureus*.

b) A much higher dose of antibiotic can be used safely.

c) Retention time of the antibiotic in the udder is longer.

d) Tissue damaged by mastitis may be regenerated before freshening.

e) The risk of contaminating milk with drug residues is reduced when the milk withholding time after calving is properly observed.

Preventing New Infections

The risk of new intramammary infection is greatest during the early and latter portions of the dry period. Most dry cow treatments provide sufficient protection after drying off so that:

a) The frequency of new infections during the dry period is reduced.

b) The incidence of clinical mastitis at freshening may be reduced.

Few products have extended activity for the entire dry period. Most have maximum activity in the first few weeks of the dry period and activity declines as the dry period length increases. If they have extended activity then particular care is needed to prevent drug residues in milk when calving occurs earlier than expected.

Dry Cow Products – Antimicrobial Infusions

Only approved commercial antibiotic products formulated specifically for dry cow therapy in single-dose containers for intramammary infusion should be used. These products contain high levels of one or more antibiotics in a slow-release base which will maintain therapeutic levels in the dry udder for a significant length of time. Further, they have been tested in field studies, meet the guidelines of the regulators, and are guaranteed to be prepared aseptically. Home remedies should not be used. All syringes used must be for single infusion only. Unapproved products and non-standard methods may lead to the infusion product becoming contaminated during mixing and through multiple use, and may spread resistant organisms. Products used for dry cow therapy should be stored in accordance with good dairy farming practices and discarded when the expiration date is reached. Outdated intramammary antibiotics may have little antibacterial activity.

Most dry cow therapy products are designed to eliminate existing infections by Gram-positive bacteria, particularly *Staphylococcus aureus* and streptococcal infections at drying off and to prevent new *S. aureus* and streptococcal infections in the early dry period. Many producers have already eliminated *Streptococcus agalactiae* and dramatically reduced the level of *S. aureus* infection in their herds. Continued use of dry cow treatment will help to maintain a good herd udder health status. In many herds and especially where dairy cattle confinement has become more intense, a higher percentage of new infections during the dry period are caused by environmental bacteria. Most dry cow therapy products are reasonably effective against environmental streptococci, especially *Streptococcus uberis*, but lack activity against Gram-negative environmental bacteria, especially the coliforms. The length of effective protection varies between products, often according to the type of antibiotic or the dose. In Europe and Australia, dry cow products providing protection up to 54 days are available. The herd veterinarian should be consulted to determine which dry cow product should be used.

Continued use of dry cow treatment – using only approved infusion products – will help maintain good herd udder health.

Using an internal sealant in combination with an antibiotic prevents significantly more new dry period infections than using antibiotic alone.

Dry Cow Products – Internal Sealant Infusions

Sealing of the teat canal by the natural keratin plug that forms during the dry period is the primary natural component protecting against new intramammary infection in the late dry period. Potential damage to that protection is one reason why repeated infusions are not recommended. It has been documented that a significant proportion of quarters experience long delays or outright failure to form a complete keratin plug during the dry period, putting these quarters at increased risk for experiencing new mastitis infections. One study has reported that this risk is increased in cows producing high levels of milk at dry off.

One method of supplementing the teat's defenses throughout the entire dry period is by use of an internal teat sealant. An artificial internal sealant is available for use alone or in combination with an antibiotic infusion. This product has no antimicrobial activity and therefore is recommended for use alone only in the uninfected udder. Otherwise, internal teat sealants should be used in conjunction with dry cow antibiotic therapy. When used alone in uninfected quarters, this product has been shown to prevent significantly more new infections than using no treatment at all, and has been shown to have equal, if not better, efficacy in preventing new infections, as compared to using antibiotic alone.
In the infected udder, or when the infection status is unknown, an antibiotic infusion is recommended. This may be accompanied by teat sealant and may be especially valuable for the longer dry period. Using the internal sealant in combination with an antibiotic prevents significantly more new dry period infections than using antibiotic alone. While internal teat sealants are most commonly used in combination with intramammary antibiotics in North America, they are also approved for combination use in most European countries. The teat sealant meets all requirements for protection of the non-lactating gland for organic herds, but this is also dependent on individual countries' requirements. It is paramount that the very best hygienic practices are adopted when infusing the teat sealant to prevent contamination of the mammary gland.

Dry Cow Products – External Sealant Infusions

Another method to supplement the cow's defenses is to apply an external sealant to teats by dipping. These products are adjuncts to antimicrobial infusion. External teat sealants presently do not have a long duration of persistency on teat ends. As long as the teat end remains covered, protection from bacteria entering the gland is provided. Thus, for continuous protection, they require visual inspection and reapplication (if required) every 5 to 7 days throughout the dry period. Alternatively, routine use and reapplication can be targeted at times of increased susceptibility, namely the late (transition) dry period.

Total vs. Selective Dry Cow Therapy

Most herds have been shown to benefit by treating every quarter of every cow at drying off with an antimicrobial infusion. This blanket approach will reach all infected quarters, is more effective than selective treatment in preventing new infections early in the dry period, and does not require laboratory screening procedures to decide which cows and quarters to treat.

When subclinical mastitis in a herd has been reduced to a very low level (i.e., every cow in the herd less than 100,000 cells/mL), using dry cow treatment only on selected higher-risk cows has been considered appropriate by some dairy producers and veterinarians. However, selective treatment may fail to reach 20% to 40% of infected quarters in a herd. Also, uninfected quarters not treated at drying off are more likely than treated quarters to become infected during the dry period. It has been shown when the cow is the unit of risk, a cow with one infected quarter is more likely to suffer another infected quarter than any quarter in an uninfected cow.

Most studies indicate that if the decision is based on economics (i.e., the cost of dry cow therapy compared to the return to the producer), treating every quarter of every cow at drying off is preferable.

Selective treatment may fail to reach 20% to 40% of infected quarters in a herd.

Proper preparation is essential in keeping infectious organisms from entering the udder.

Infusion Procedures

The teats must be cleaned and sanitized carefully before any infusion. Without proper preparation, organisms present on the teat end may be forced into the udder and result in a severe infection especially if Gram-negative bacteria are introduced.

The best procedure is to follow these easy steps:

a) Clean and dry teats.

b) Dip teats in an effective germicidal product. Allow 30 seconds contact time before wiping teats with an individual disposable towel.

c) Thoroughly clean and disinfect each teat end, paying particular care to the teat orifice, by scrubbing with a cotton swab soaked in 70% alcohol. Use a separate piece of cotton for each teat.

d) Prepare teats on the far side of the udder first, followed by teats on the near side. (Teats may be cleaned and infused individually, if necessary.)

e) Treat quarters in reverse order: near side first, far side last.

f) Insert only the tip of the cannula into the teat end and express all of the contents. Do not allow the sterile cannula to touch anything prior to infusion.

g) Do not massage the teats to disperse the product.

h) Dip teats in an effective germicidal product after treatment.

i) Identify treated cows and remove them from the milking herd to prevent antibiotics from entering the milk supply.

Drying-Off Methods

Concentrate feeding of high-producing cows should be stopped two weeks before the anticipated drying off to reduce daily yield (target less than 35 lbs. or 15 kg per day). A change in environment can also help reduce production. Abrupt cessation of milking is recommended when the target daily yield has been achieved. Intermittent milking along with a decrease in the energy concentration of the ration can be used as a method to achieve the target yield. Cows should be observed closely for the first two weeks after drying off to ensure that udders are involuting properly. Udders with swollen quarters should be examined for mastitis.

Feed and environment changes can help reduce production prior to dry off.

Number of Infusions

Research to date indicates there is little, if any, value in treating cows at drying off with multiple infusions, where multiple infusions refers to treating twice at drying off, or at dry off and at some later time. Subsequent treatments may pose the additional risk of forcing bacteria into the gland as well as increase the risk of antibiotics in milk after freshening. However, in some countries, in some seasons and in some high-risk environments, particular problems (i.e., summer mastitis) may warrant additional treatment three weeks prior to calving, subject to veterinary advice. An alternate strategy to provide continuous protection throughout the dry period may be to infuse an internal teat sealant in combination with an antibiotic at time of dry off.

Preventing Drug Residues

Attention must be given to preventing drug residues in milk and meat. Label directions must be followed exactly to avoid drug residues after freshening, especially when cows have shorter than normal dry periods. Tests are available to determine antibiotic residues in milk. Most dairy cooperatives, direct milk purchasers, and many veterinary clinics will run these tests. Kits are available for use on-farm. If the dry period is unexpectedly short or additional treatment has been used, or when any other doubt exists, then each cow should be tested before consigning milk.

Sanitation / Dry Cow Management

All areas used by dry cows should be clean and dry to minimize the opportunity for infection.

Because udders are not milked during the dry period, pathogens are not flushed out of the lower portion of the teat canal. This may lead to new intramammary infections especially by skin-colonizing staphylococci. The number of new infections is related to the bacterial population on teat ends. Therefore, exercise lots, loafing areas, stalls and maternity pens should be clean and dry. Animals on pasture should not be allowed in ponds and muddy areas.

Dry cow treatment may be helpful in preventing new infections during the early dry period. However, the udder is vulnerable to new infections during the last two or three weeks of the dry period when dry cow therapy is no longer effective. Special attention must be given to springing cows and heifers. These animals must be kept clean and dry if mastitis is to be avoided during early lactation. Weather permitting, a clean grassy lot or paddock is an ideal calving area. A clean box stall with clean bedding, preferably straw or inorganic bedding, is recommended during inclement weather. In the week immediately prior to calving, it is valuable to examine the udder daily and to use an effective teat dip on all teats.

Nutritional management of the dry (transition) cow should also be considered in the mastitis prevention program. For example, a negative energy balance or deficiencies in vitamin (i.e., Vitamins A, D, E) or trace mineral (i.e., selenium, copper or zinc) status during the transition period can result in impaired immune function. Producers should work with a qualified nutritionist to provide a dry (transition) cow diet balanced to meet current recommended nutrient intake guidelines.

Summary

1) Research indicates that most herds will benefit from properly treating all quarters of all cows at drying off with an antimicrobial infusion.

2) Take special care in cleaning and sanitizing teats prior to infusing antibiotics into a quarter.

3) Use only approved commercial antibiotic products which have been formulated specifically for dry cow therapy and which are available in single-dose containers for intramammary infusion.

4) A teat sealant may be appropriate for some cows and some herds.

5) Reduce nutrient intake of cows one to two weeks prior to drying off.

6) Place dry cows in a clean and dry environment.

7) Observe dry cows periodically for swollen quarters, which may indicate intramammary infection.

Dry cow therapy is an important element of an effective mastitis control program.

For more information, contact the National Mastitis Council.

The NMC is a not-for-profit educational organization that provides a forum for global exchange of information about milk quality, mastitis, and relevant research. The NMC strives to communicate that information to all segments of the dairy industry.

Schering-Plough

Orbenin-DC®

Orbenin-DC® (benzathine cloxacillin)

A Shorter Dry Period or the Classic 60-Day Dry Period?

Either way, ORBENIN-DC is the most convenient dry-cow mastitis tube available. A combination of flexibility and efficacy make ORBENIN-DC the preferred choice over other tubes, including Quartermaster® and Cefa-Dri.® As you can see, ORBENIN-DC has a broad spectrum of antibacterial activity and requires no milk withhold after a 28-day dry period.

Label Claims	ORBENIN-DC	Quartermaster	Cefa-Dri
Spectrum of Activity	*Staphylococcus aureus* *Streptococcus agalactiae* Penicillin G-resistant staphylocci	*Staph. aureus*	*Staph. aureus* *Strep. agalactiae* Penicillin G-resistant staphylocci
Required Dry Period	28 Days	42 Days	30 Days
Milk Withhold	0 Hours	96 Hours	72 Hours

Shortest Required Dry Period and Milk Withhold

- Peace of mind for food safety
- No milk testing
- Fresh cows move into the milking string faster

Long Acting

- Long duration of effect[1]
- Antibacterial activity late in the dry period

Kills Bacteria

- ORBENIN-DC tubes are bactericidal in action

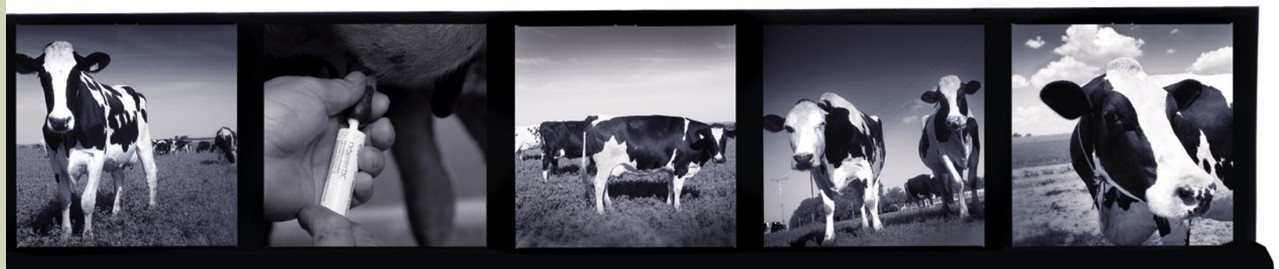
Know the Bug. Choose the Drug.

Schering-Plough Animal Health Corporation recommends establishing a mastitis control program that includes routine culturing.

See Your Veterinarian for ORBENIN-DC Mastitis Tubes

This product has the potential for producing allergic reactions. It should not be used in a cow that may have a dry period of less than four weeks.

[1]Data on file at Schering-Plough Animal Health Corporation.



Schering-Plough

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TAKE TIME
OBSERVE LABEL DIRECTIONS

Orbenin-DC®
(benzathine cloxacillin)

DRY COW
(VACA SECA)

Intramammary Infusion
(Infusión intramamaria)

LONG ACTING FORMULA
(FÓRMULA DE LARGA ACCIÓN)

CAUTION: Federal law restricts this drug to use by or on the order of a licensed veterinarian.

DESCRIPTION: Orbenin-DC (benzathine cloxacillin) is a stable, nonirritating suspension of benzathine cloxacillin containing the equivalent of 500 mg of cloxacillin per disposable syringe. Orbenin-DC is manufactured by a nonsterilizing process.

Benzathine cloxacillin is a semisynthetic penicillin derived from the penicillin nucleus, 6-amino-penicillanic acid. Benzathine cloxacillin is the benzathine salt of 6-[3-(2-chlorophenyl)-5-methylisoxazolyl-4-carboxamido] penicillanic acid.

The low solubility of Orbenin-DC results in an extended period of activity. Therefore, directions for use should be followed explicitly.

ACTION: Benzathine cloxacillin is bactericidal in action against susceptible organisms during the stage of active multiplication. It acts through the inhibition of biosynthesis of cell wall mucopeptide. It is active against gram-positive organisms associated with mastitis such as *Staphylococcus aureus* and *Streptococcus agalactiae* and, because of its resistance to penicillinase, penicillin G-resistant staphylococci which may be the cause of mastitis.

Appropriate laboratory tests should be conducted, including *in vitro* culturing and susceptibility tests on pretreatment milk samples collected aseptically.

SUSCEPTIBILITY TEST: The Kirby-Bauer* procedure, utilizing antibiotic susceptibility disks, is a quantitative method that may be adapted to determining the sensitivity of bacteria in milk to Orbenin-DC.

For testing the effectiveness of Orbenin-DC in milk, follow the Kirby-Bauer procedure using the 1 mcg **oxacillin** susceptibility disk. Zone diameters for interpreting susceptibility are:

Resistant	Intermediate	Susceptible
" 10 mm	11–12 mm	≥ 13 mm

* Bauer AW, Kirby WMM, Sherris JC, *et al:* Antibiotic testing by a standardized single disk method, *Am J Clin Path* 45:493, 1966. Standardized Disk Susceptibility Test, Federal Register 37:20527–29, 1972.

INDICATIONS: Orbenin-DC is indicated in the treatment and prophylaxis of bovine mastitis in nonlactating cows due to *Staphylococcus aureus* and *Streptococcus agalactiae*.

CONTRAINDICATIONS: Because benzathine cloxacillin is relatively insoluble, Orbenin-DC's activity will be prolonged. Therefore, Orbenin-DC should not be used for the occasional cow which may have a dry period of less than 4 weeks. This precaution will avoid residues in the milk following removal of the colostrum.

WARNINGS: For use in dry cows only. Do not use within 4 weeks (28 days) of calving. Treated animals must not be slaughtered for food purposes within 4 weeks (28 days) of treatment.

PRECAUTION: Because it is a derivative of 6-amino-penicillanic acid, Orbenin-DC has the potential for producing allergic reactions. Such reactions are rare; however, should they occur, the subject should be treated with the usual agents (antihistamines, pressor amines).

DOSAGE AND ADMINISTRATION: At the last milking of lactation, milk the cow out normally. Clean and disinfect the teats with alcohol swabs provided in the carton, and infuse 1 syringe of Orbenin-DC, which has been warmed to room temperature, into each quarter. Do not milk out. The cow may be milked as usual when she calves.

The extent of subclinical and latent mastitis in a herd is frequently greater than suspected. In untreated herds a significant buildup of subclinical mastitis may occur during the dry period, which results in clinical severity after a few lactations. The adverse influence of subclinical mastitis on milk yield, the risk of cross-infection, and the chance of clinical mastitis flare-up make it necessary to treat the matter as a herd problem. Clinical studies have proven the value of treating all the cows in heavily infected herds as they are dried off. When the herd infection has been reduced, it may be desirable to be more selective in treating infected quarters.

Each carton contains 12 alcohol swabs to facilitate proper cleaning and disinfecting of the teat orifice.

HOW SUPPLIED: Orbenin-DC is supplied in cartons of 12 single-dose syringes with 12 alcohol swabs. Each disposable syringe contains 500 mg of cloxacillin as the benzathine salt in 7.5 g of suitable base.

Do Not Store Above 24°C (75°F)

Orbenin-DC® is a trademark owned by and used under license from SmithKline Beecham.

NADA #55-069, Approved by FDA

Manufactured by:
G.C. Hanford Mfg. Co.
Syracuse, NY 13201

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27865909

Schering-Plough

Amoxi-Mast®

Amoxi-Mast® (amoxicillin)

Rely on the Broad-Spectrum Power of Amoxi-Mast: Urgent Care for Lactating Cows

- Demonstrated 86% cure rate for *Streptococcus agalactiae*, the target of lactating cow therapy in the U.S.[1] More cures mean more milk.
- Broad-spectrum therapy against the major mastitis-causing agents *Strep. agalactiae* and penicillin-sensitive *Staphylococcus aureus*. You can treat with confidence in outcomes.
- Consistently associated with increased cure rates for subclinical mastitis.[1] Curing subclinical cases can help limit the circulation of mastitis in the herd.
- Readily absorbed into udder tissue for excellent effectiveness.
- Economical 60-hour milkout.

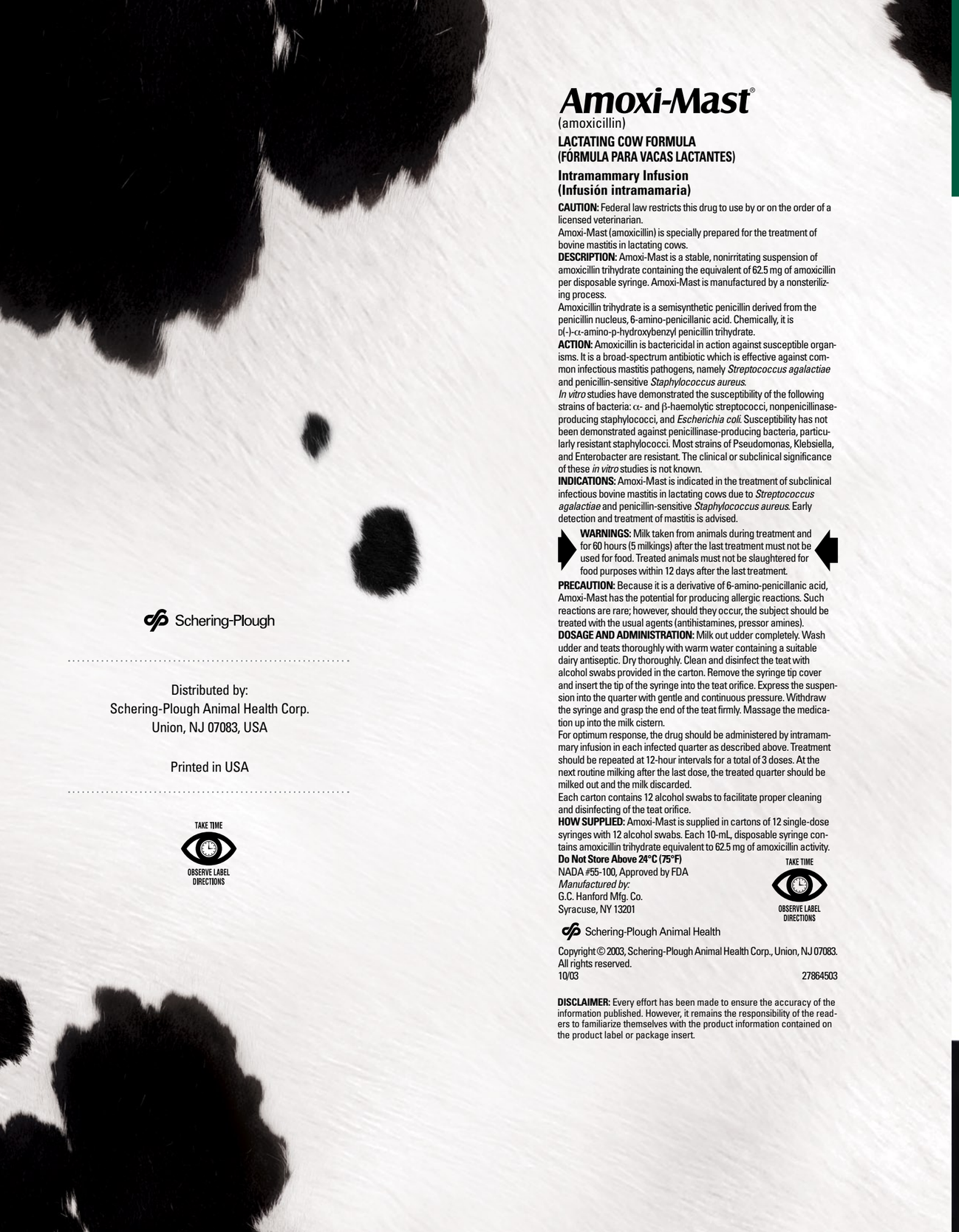
LACTATING COW SPECTRUM OF ACTIVITY

Product	*Streptococcus agalactiae*	*Staphylococcus aureus*	ß-lactamase *Staphylococcus*	Cure Rate (*Strep. ag*)	Milkings Lost
Amoxi-Mast®	x	x	In vitro	86%	7
Dariclox®	x	x		77%	6
Cefa-Lak®	x	x		66%	9
Pirsue®	x	x		44%	5
ToDay®	x	x		66%	9

Amoxi-Mast has the highest cure rate for *Strep. agalactiae* and a low milk-out period, for maximum cost-effectiveness.

This product has the potential for producing allergic reactions.

[1]Wilson, DJ et al. Comparison of seven antibiotic treatments with no treatment for bacteriological efficacy against bovine mastitis pathogens. *J Dairy Sci* 1999; 82:1664-1670.
[2]Based on label claims.
[3]Based on two milkings per day.



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Union, NJ 07083, USA

Printed in USA

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Amoxi-Mast®
(amoxicillin)

LACTATING COW FORMULA
(FÓRMULA PARA VACAS LACTANTES)

Intramammary Infusion
(Infusión intramamaria)

CAUTION: Federal law restricts this drug to use by or on the order of a licensed veterinarian.

Amoxi-Mast (amoxicillin) is specially prepared for the treatment of bovine mastitis in lactating cows.

DESCRIPTION: Amoxi-Mast is a stable, nonirritating suspension of amoxicillin trihydrate containing the equivalent of 62.5 mg of amoxicillin per disposable syringe. Amoxi-Mast is manufactured by a nonsterilizing process.

Amoxicillin trihydrate is a semisynthetic penicillin derived from the penicillin nucleus, 6-amino-penicillanic acid. Chemically, it is D(-)-α-amino-p-hydroxybenzyl penicillin trihydrate.

ACTION: Amoxicillin is bactericidal in action against susceptible organisms. It is a broad-spectrum antibiotic which is effective against common infectious mastitis pathogens, namely *Streptococcus agalactiae* and penicillin-sensitive *Staphylococcus aureus*.

In vitro studies have demonstrated the susceptibility of the following strains of bacteria: α- and β-haemolytic streptococci, nonpenicillinase-producing staphylococci, and *Escherichia coli*. Susceptibility has not been demonstrated against penicillinase-producing bacteria, particularly resistant staphylococci. Most strains of Pseudomonas, Klebsiella, and Enterobacter are resistant. The clinical or subclinical significance of these *in vitro* studies is not known.

INDICATIONS: Amoxi-Mast is indicated in the treatment of subclinical infectious bovine mastitis in lactating cows due to *Streptococcus agalactiae* and penicillin-sensitive *Staphylococcus aureus*. Early detection and treatment of mastitis is advised.

WARNINGS: Milk taken from animals during treatment and for 60 hours (5 milkings) after the last treatment must not be used for food. Treated animals must not be slaughtered for food purposes within 12 days after the last treatment.

PRECAUTION: Because it is a derivative of 6-amino-penicillanic acid, Amoxi-Mast has the potential for producing allergic reactions. Such reactions are rare; however, should they occur, the subject should be treated with the usual agents (antihistamines, pressor amines).

DOSAGE AND ADMINISTRATION: Milk out udder completely. Wash udder and teats thoroughly with warm water containing a suitable dairy antiseptic. Dry thoroughly. Clean and disinfect the teat with alcohol swabs provided in the carton. Remove the syringe tip cover and insert the tip of the syringe into the teat orifice. Express the suspension into the quarter with gentle and continuous pressure. Withdraw the syringe and grasp the end of the teat firmly. Massage the medication up into the milk cistern.

For optimum response, the drug should be administered by intramammary infusion in each infected quarter as described above. Treatment should be repeated at 12-hour intervals for a total of 3 doses. At the next routine milking after the last dose, the treated quarter should be milked out and the milk discarded.

Each carton contains 12 alcohol swabs to facilitate proper cleaning and disinfecting of the teat orifice.

HOW SUPPLIED: Amoxi-Mast is supplied in cartons of 12 single-dose syringes with 12 alcohol swabs. Each 10-mL, disposable syringe contains amoxicillin trihydrate equivalent to 62.5 mg of amoxicillin activity.

Do Not Store Above 24°C (75°F)
NADA #55-100, Approved by FDA
Manufactured by:
G.C. Hanford Mfg. Co.
Syracuse, NY 13201

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Schering-Plough Animal Health

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Schering-Plough

Dariclox®

Dariclox® (sodium cloxacillin)

Saves Milk and Money by Improving Udder Health

- Demonstrated 77% cure rate for *Streptococcus agalactiae* in study of antibiotic treatments.[1]
- Highly effective against mastitis caused by *Staphylococcus aureus* as well as *Strep. agalactiae*.
- Quickly achieves high therapeutic levels, with proven antibacterial action for quick effect.
- Economical 48-hour milkout.

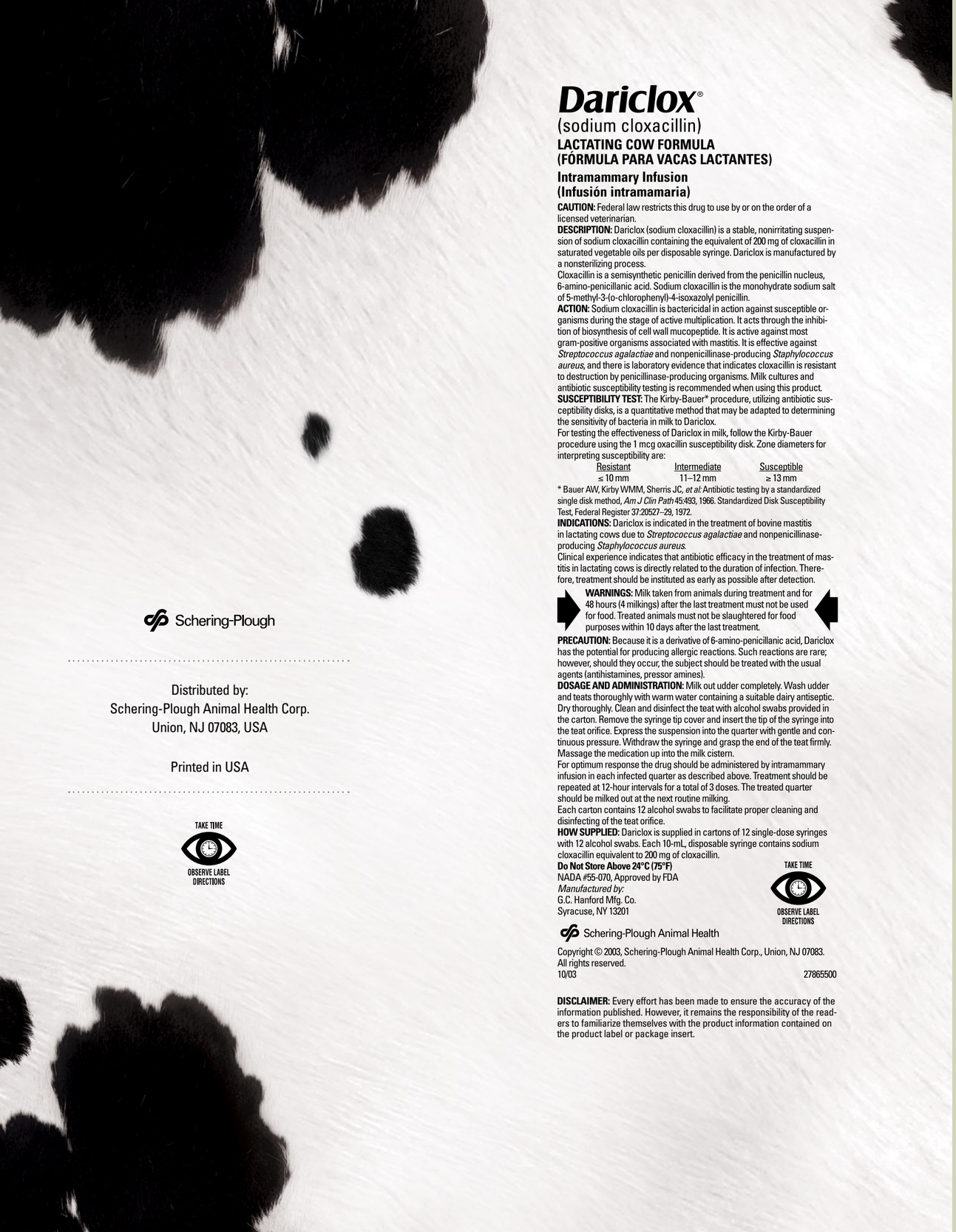
LACTATING COW SPECTRUM OF ACTIVITY

Product	*Streptococcus agalactiae*	*Staphylococcus aureus*	ß-lactamase *Staphylococcus*	Cure Rate (*Strep. ag*)	Milkings Lost
Amoxi-Mast®	x	x	In vitro	86%	7
Dariclox®	x	x		77%	6
Cefa-Lak®	x	x		66%	9
Pirsue®	x	x		44%	5
ToDay®	x	x		66%	9

Dariclox has one of the highest cure rates for *Strep. agalactiae* and one of the lowest milk-out periods, for maximum cost-effectiveness.

This product has the potential for producing allergic reactions.

[1]Wilson, DJ et al. Comparison of seven antibiotic treatments with no treatment for bacteriological efficacy against bovine mastitis pathogens. *J Dairy Sci* 1999; 82:1664-1670.
[2]Based on label claims.
[3]Based on two milkings per day.



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Dariclox®

(sodium cloxacillin)

LACTATING COW FORMULA
(FÓRMULA PARA VACAS LACTANTES)

Intramammary Infusion
(Infusión intramamaria)

CAUTION: Federal law restricts this drug to use by or on the order of a licensed veterinarian.

DESCRIPTION: Dariclox (sodium cloxacillin) is a stable, nonirritating suspension of sodium cloxacillin containing the equivalent of 200 mg of cloxacillin in saturated vegetable oils per disposable syringe. Dariclox is manufactured by a nonsterilizing process.

Cloxacillin is a semisynthetic penicillin derived from the penicillin nucleus, 6-amino-penicillanic acid. Sodium cloxacillin is the monohydrate sodium salt of 5-methyl-3-(o-chlorophenyl)-4-isoxazolyl penicillin.

ACTION: Sodium cloxacillin is bactericidal in action against susceptible organisms during the stage of active multiplication. It acts through the inhibition of biosynthesis of cell wall mucopeptide. It is active against most gram-positive organisms associated with mastitis. It is effective against *Streptococcus agalactiae* and nonpenicillinase-producing *Staphylococcus aureus,* and there is laboratory evidence that indicates cloxacillin is resistant to destruction by penicillinase-producing organisms. Milk cultures and antibiotic susceptibility testing is recommended when using this product.

SUSCEPTIBILITY TEST: The Kirby-Bauer* procedure, utilizing antibiotic susceptibility disks, is a quantitative method that may be adapted to determining the sensitivity of bacteria in milk to Dariclox.

For testing the effectiveness of Dariclox in milk, follow the Kirby-Bauer procedure using the 1 mcg oxacillin susceptibility disk. Zone diameters for interpreting susceptibility are:

Resistant	Intermediate	Susceptible
≤ 10 mm	11–12 mm	≥ 13 mm

* Bauer AW, Kirby WMM, Sherris JC, *et al:* Antibiotic testing by a standardized single disk method, *Am J Clin Path* 45:493, 1966. Standardized Disk Susceptibility Test, Federal Register 37:20527–29, 1972.

INDICATIONS: Dariclox is indicated in the treatment of bovine mastitis in lactating cows due to *Streptococcus agalactiae* and nonpenicillinase-producing *Staphylococcus aureus.*

Clinical experience indicates that antibiotic efficacy in the treatment of mastitis in lactating cows is directly related to the duration of infection. Therefore, treatment should be instituted as early as possible after detection.

WARNINGS: Milk taken from animals during treatment and for 48 hours (4 milkings) after the last treatment must not be used for food. Treated animals must not be slaughtered for food purposes within 10 days after the last treatment.

PRECAUTION: Because it is a derivative of 6-amino-penicillanic acid, Dariclox has the potential for producing allergic reactions. Such reactions are rare; however, should they occur, the subject should be treated with the usual agents (antihistamines, pressor amines).

DOSAGE AND ADMINISTRATION: Milk out udder completely. Wash udder and teats thoroughly with warm water containing a suitable dairy antiseptic. Dry thoroughly. Clean and disinfect the teat with alcohol swabs provided in the carton. Remove the syringe tip cover and insert the tip of the syringe into the teat orifice. Express the suspension into the quarter with gentle and continuous pressure. Withdraw the syringe and grasp the end of the teat firmly. Massage the medication up into the milk cistern.

For optimum response the drug should be administered by intramammary infusion in each infected quarter as described above. Treatment should be repeated at 12-hour intervals for a total of 3 doses. The treated quarter should be milked out at the next routine milking.

Each carton contains 12 alcohol swabs to facilitate proper cleaning and disinfecting of the teat orifice.

HOW SUPPLIED: Dariclox is supplied in cartons of 12 single-dose syringes with 12 alcohol swabs. Each 10-mL, disposable syringe contains sodium cloxacillin equivalent to 200 mg of cloxacillin.

Do Not Store Above 24°C (75°F)
NADA #55-070, Approved by FDA
Manufactured by:
G.C. Hanford Mfg. Co.
Syracuse, NY 13201

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