Effectively Using Antibiotics To Treat Mastitis

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Prudent use of antibiotics is front and center in headlines found in print, talk shows, and social media. Sorting out this issue and its relationship with the dairy industry, especially as it relates to the control and treatment of mastitis, can be confusing and complex. To better understand this issue, we need to first understand the susceptibility of bacteria to antibiotics, how this susceptibility might change over time, and whether scientific evidence exists for antibiotic resistance in dairy cows. With this knowledge, we can design more effective mastitis treatment protocols and determine when antibiotic use is needed, leading to the prudent use of antibiotics to protect the health and well-being of dairy cows.

Why are bacteria resistant to antibiotics?

Antibiotics are medications used to treat bacterial infections by either killing or inhibiting the growth of certain microorganisms. They are designed to target specific structures or compounds within bacteria cells, resulting in the death of the bacteria itself. Antibiotics can be ineffective if they do not target the correct cell structure or the bacterium learns how to defend itself against the antibiotic. These changes within the bacterial cell result in antibiotic resistance, whereas the inappropriate selection of antibiotics for the particular type of bacteria results in ineffective treatment. In addition, the failure to administer antibiotics for the recommended time period or dose can lead to treatment failure and possibly increased antibiotic resistance. To further explain the implications of these mechanisms on-farm, let's look at these in more detail.

1) *Cell structure, specifically the cell wall composition:* Gram-negative and Gram-positive bacteria have a different type of cell wall structure and certain antibiotics are more effective for each of these types of bacteria. Antibiotics labeled for Gram-positive bacteria have difficulty penetrating the cell wall found in Gram-negative bacteria, rendering them ineffective on Gram-negatives. Thus, culturing to determine the infecting bacteria type helps determine which antibiotic will be more effective in treating the infection and whether use of an antibiotic is warranted.

2) *Bacteria develop the ability to defend themselves against an antibiotic:* Bacteria can also acquire defenses to decrease the effectiveness of the antibiotic overtime, commonly referred to as antibiotic resistance. The development of this defense by the bacterial cell can occur through minimizing the amount of antibiotic allowed through the cell wall, changing how the antibiotic works within the bacteria, or how the antibiotic is degraded within the bacterial cell. These changes result in a once effective antibiotic no longer being effective.

Are mastitis pathogens resistant to antibiotics?

Oliver and Murinda (2012) compiled data from multiple studies to determine whether mastitis pathogens were resistant to antibiotics and if changes in resistance occurred over time. Overall, they concluded that little evidence suggests widespread or emerging resistance of mastitis pathogens to intramammary antibiotics. Other factors, besides antibiotic use in dairy cattle, may be involved in antibiotic resistance and needs to be investigated before conclusions can be drawn. Based on our current understanding, certain steps can be taken to ensure the responsible use of antibiotics and increase the effectiveness of antibiotic treatment of mastitis cases.

Judicious use of antibiotics

1) *Work with your veterinarian to develop strategies for dealing with mastitis:* Depending on the mastitis pathogen, certain antibiotics may or may not be effective. The purpose of antibiotic therapy is to aid the cow's immune system to fight off the infection and, in some cases, the immune system does not need help. For example, the immune system can fight off an *E. coli* infection 80 to 95% of the time without antibiotics.

2) *Know what you're dealing with:* Culturing milk from cows with mastitis gives a critical piece of information to make the proper treatment or management decision. For example, some bacteria respond to a particular antibiotic while others do not respond well to any. Treating with an antibiotic might not always be the best decision. For example, antibiotics are not effective for treating mastitis caused by *Serratia spp.* or *Pseudomonas spp*. However, if a milk culture is positive for *Strep. dysgalactiae* (See Table), your veterinarian would most likely recommend a broad-spectrum antibiotic. Sensitivity tests in the lab may or may not equate to effectiveness of the drug to treat mastitis cases. For more information, a "Reference Guide for mastitis-causing bacteria" is available to help farmers discuss treatment options with their veterinarian.

3) *Follow drug labels:* The majority of intramammary antibiotics are labeled to target Gram-negative or Gram-positive bacteria. By examining drug labels, we can determine whether that antibiotic will be effective for the mastitis case in question. Each label also displays the number of days in which the product should be administered along with milk and meat withdrawal times based on the recommended treatment protocol.

4) *Keep proper written or electronic records:* For each case of mastitis whether treated or not, record the cow's ID, days in milk, the severity of the case, quarter, pathogen, treatment given, and milk and meat withdrawal associated with treatment. By having a written log of past mastitis cases, more information is available when it comes to making future treatment decisions. For example, if after reviewing records, the cow in question has had three previous mastitis cases in the same lactation, it might be

time to cull the cow from the herd instead of treating her again. Cow records need to be in a format (i.e. paper version or backed-up computer file) that can be accessed at least 3 years from the date of treatment. By keeping written records, treatments as well as adherence to withdrawal times can be documented if FDA questions meat withdrawal times for a particular cow.

5) *Prevention, prevention, prevention:* The most responsible use of antibiotics is preventing their use from the beginning. Proper milking procedures, properly administering dry cow therapy and/or teat sealant, vaccinating against coliform pathogens according to product label, and keeping cows as clean and dry as possible are mastitis prevention strategies to implement on every dairy farm.

Table. Abbreviated version of "Reference guide for mastitis-causing bacteria"

Bacteria	Source	Spread	Control	Treatment**
Staph. Aureus	Infected udders Hands of milkers	Milking	Post-dip Segregation Cull	Early Lactation - 8 days of pirlimycin. Do not treat chronic infections.
Strep. dysgalactiae	Environmental	Environment	Dry cow treatment Teat sealant Clean environment	Label recommendation for broad spectrum intramammary antibiotic.
Serratia	Environmental	Environment	Clean and dry cows Pre-dip	Does not respond to antibiotics.

*Adopted from table *Reference guide for mastitis-causing bacteria* developed by C. S. Petersson-Wolfe (Virginia Tech Mastitis & Immunology Laboratory) and M. Arnold (University of Kentucky)
**Always consult a veterinarian before making antibiotic treatment decisions.

Antibiotics infused into the mammary gland are a useful tool when dealing with mastitis cases. However, depending on the infecting pathogen, a particular antibiotic or treatment protocol may or may not be effective. By keeping accurate records, preventing new mastitis cases, and considering cow history and infecting pathogen before treatment, antibiotic use can continue to be used effectively to improve the health and well-being of dairy cows.

References

Oliver, S. P. and S. E. Murinda. 2012. Antimicrobial Resistance of Mastitis Pathogens. Veterinary Clinics of North America: Food Animal Practice 28(2):165-185.

Ruegg, P. L. 2018. Making Antibiotic Treatment Decisions for Clinical Mastitis. Veterinary Clinics: Food Animal Practice 34(3):413-425.