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## ***Calf Note #87 - Calf feeding programs and control of brucellosis and tuberculosis***

NOTE: The following is the paper I recently presented at the 2002 CIGAL Meeting in Guadalajara, Mexico. Because diseases such as brucellosis and tuberculosis are so important in many parts of the world, it's important to review, from time to time, how management approaches such as commercial feeding programs can help to reduce the spread of these costly diseases. Jim.

### **Introduction**

Control of diseases in modern dairy farms is becoming increasingly important. Increased movement of animals from farm to farm and across geographic and political borders has made control of diseases such as tuberculosis and brucellosis increasingly important. Further, improved animal testing and epidemiological studies allows more rapid analysis of potential disease outbreaks. Therefore, understanding the causes of disease – particularly, management factors that can influence the transmission of disease – can help to eliminate the disease from the farm. The objective of this paper is to review the role of commercially available products (colostrum supplements and milk replacers) as tools in a management plan to control brucellosis and tuberculosis on dairy farms. We'll begin with a brief review of brucellosis and tuberculosis.

### **Brucellosis**

Brucellosis is a contagious, costly disease of ruminant animals that also affects humans. Although brucellosis can attack other animals, its main threat is to cattle, bison, and swine. The disease is also known as contagious abortion or Bang's disease. The damage done by brucellosis includes decreased milk production, weight loss, loss of young (abortions), infertility, and lameness. Therefore, it is one of the most serious diseases of livestock. The speed with which it spreads and the fact that it is transmissible to humans makes it the more serious.

The disease is caused by the genus *Brucella*. Three species of *Brucella* cause the most concern: *B. abortus*, principally affecting cattle and bison; *B. suis*, principally affecting swine and reindeer but also cattle and bison; and *B. melitensis*, principally affecting goats. In cattle, the disease currently localizes in the reproductive organs and/or the udder. Bacteria are shed in milk or via the aborted fetus, afterbirth, or other reproductive tract discharges.

There is no effective way to detect infected animals by their appearance. The most obvious signs in pregnant animals are abortion or birth of weak calves. Milk production may be reduced from changes in the normal lactation period caused by abortions and delayed conceptions. Not all infected cows abort, but those that do usually abort between the fifth and seventh month of pregnancy. Infected cows usually abort once, but a percentage will abort during additional pregnancies, and calves born from later pregnancies may be weak and unhealthy. Even though their calves may appear healthy, infected cows continue to harbor and discharge infectious organisms and should be regarded as dangerous sources of the disease. Other signs of brucellosis include an

apparent lowering of fertility with poor conception rates, retained afterbirths with resulting uterine infections, and (occasionally) enlarged, arthritic joints.

Brucellosis is commonly transmitted to susceptible animals by direct contact with infected animals or with an environment that has been contaminated with discharges from infected animals. Aborted fetuses, placental membranes or fluids, and other vaginal discharges present after an infected animal has aborted or calved are all highly contaminated with infectious *Brucella*. Contaminated colostrum and milk is also a vector for transmission. Despite occasional exceptions, the general rule is that brucellosis is carried from one herd to another by an infected or exposed animal. This mode of transmission occurs when a herd owner buys replacement cattle that are infected or have been exposed to infection prior to purchase. The disease may also be spread when wild animals or animals from an affected herd mingle with brucellosis-free herds.

In the United States, once an infected herd is located, the infection is contained by quarantining all infected and exposed cattle and limiting their movement to slaughter only, until the disease can be eliminated from the herd. Diagnostic tests are used to find all infected cattle and bison. Also, Federal and State animal health officials check neighboring herds and others that may have received animals from the infected herd. All possible leads to additional infection are traced.

An *incubation period* is the interval of time between exposure to an infectious dose of organism and the first appearance of disease signs. The incubation period of brucellosis in cattle and other animals is quite variable ranging from about 2 weeks to 1 year and even longer in certain instances. When abortion is the first sign observed, the minimum incubation period is about 30 days. Some animals abort before developing a positive reaction to the diagnostic test. Other infected animals may never abort. Generally, infected animals that do not abort develop a positive reaction to the diagnostic test within 30 to 60 days after infection, although some may not develop a positive reaction for several months to over a year.

There is no cure for brucellosis in animals. Occasionally, animals may recover after a period of time. More commonly, however, only the signs disappear and the animals remain diseased. Such animals are dangerous sources of infection for other animals with which they associate.

## **Bovine Tuberculosis**

Tuberculosis (TB) is a contagious disease of both animals and humans. It is caused by three specific types of bacteria: *Mycobacterium bovis*, *M. avium*, and *M. tuberculosis*.

Bovine TB, caused by *M. bovis*, can be transmitted from livestock to humans and other animals. No other TB organism has as great a host range as bovine TB, which can infect all warm-blooded vertebrates. *M. avium* can affect all species of birds, as well as hogs and cattle. *M. tuberculosis* primarily affects humans but can also be transmitted to hogs, cattle, and dogs.

Bovine TB has affected animal and human health since antiquity. Once the most prevalent infectious disease of cattle and swine in the United States, bovine TB caused more losses among U.S. farm animals in the early part of this century than all other infectious diseases combined. Begun in 1917, the U.S. government and U.S. livestock producers nearly eradicated bovine TB from the livestock

population in the U.S. This disease's presence in humans has been reduced as a result of the eradication program, advances in sanitation and hygiene, the discovery of effective drugs, and pasteurization of milk.

In general, disease-causing mycobacteria live only a few weeks outside a host's body because they cannot tolerate prolonged exposure to heat, direct sunlight, or dry conditions. Under cold, dark, and moist conditions, the organisms can survive longer. Mycobacteria do not grow outside of a host except in cultured media, where they multiply approximately once every 20 hours. Because of this relatively slow rate of growth, the disease usually takes many months to develop. In some instances, the organisms lie dormant within the host's body for its lifetime, both in animals and in humans, without causing progressive disease.

Bovine TB is a chronic disease, seldom becoming apparent until it has reached an advanced stage in cattle and swine. Some infected livestock seem to be in prime condition, showing no evidence of infection until they are slaughtered, yet they may be found so seriously infected during slaughter inspection that their carcasses must be condemned.

Bovine TB can be transmitted from animals to humans and vice versa. Young animals and humans can contract the disease by drinking raw milk from infected dams and through respiration. The respiratory route is most common. Invisible droplets (aerosols) containing TB bacteria may be exhaled or coughed out by infected animals and then inhaled by susceptible animals or humans. The risk of exposure is greatest in enclosed areas, such as barns. Inhalation of aerosols is the most common route of infection for farm and ranch workers and veterinarians who work with diseased livestock. Livestock also are more likely to infect each other when they share a common watering place contaminated with saliva and other discharges from infected animals. Calves, hogs, and humans can contract bovine TB when they drink unpasteurized milk from infected cows.

TB lesions may be found in any organ or body cavity of diseased animals. In early stages of the disease, these lesions are difficult to find, even during post mortem examination. But in later stages, the nodules or lumps caused by bovine TB become very evident in the lungs and associated lymph nodes and in the lymph nodes of the head and intestinal tract. Lesions may also appear in the abdominal organs, reproductive organs, nervous system, superficial body lymph nodes, and bones.

Humans and animals with TB develop an immune response, which can be detected by the tuberculin skin test. Tuberculin is a sterile laboratory product made by growing TB bacteria, killing them with heat, removing them from the substance on which they were grown, and properly diluting and preserving the remaining mixture. About 72 hours after tuberculin is injected into animals affected with TB, a characteristic swelling reaction appears at the point of injection. This reaction is a positive test result, indicating exposure to one type of mycobacteria.

Bovine TB can be controlled within an affected herd through regular testing and slaughter of any single animal that tests positive until the entire herd tests negative for this disease. However, because there is no method available to ensure that bovine TB has been eliminated from an affected herd, APHIS recommends herd depopulation.

### **Animal Feeds and Control of Disease**

The proper use of animal feeds, including colostrum supplements and milk replacers, can be an

effective way to reduce the chances of transmitting brucellosis or tuberculosis. In all cases, processing of key ingredients – the animal proteins – effectively reduces the risk of infection. The key methods of processing include pasteurization and spray-drying.

*Pasteurization* can be conducted by heating products to 63 C for 30 minutes or 72 C for 15 seconds. Pasteurization has been shown to effectively reduce or eliminate the number of pathogenic organisms, including Brucella and Mycobacterium. Pasteurization of whole milk is responsible for the dramatic reduction of TB in human populations; so it follows that pasteurization of milk or milk proteins would also reduce the risk of infectivity. Most pasteurization done commercially is performed in dedicated equipment under tight control. Therefore, pasteurization of animal proteins used commercially is very effective in reducing the numbers of pathogens. Furthermore, milk used to produce milk proteins used commercially do not contain waste milk, which may have different characteristics which can affect the quality of pasteurization.

*Spray-drying* of animal proteins (whey proteins, blood and plasma proteins and egg proteins) exposes the ingredients to temperatures in excess of 200 C during the spray-drying process. Typically, spray-dryers heat the inlet of the dryer to >200 C; the liquid solutions are injected into the spray drier under high pressure. The liquid is then atomized into tiny droplets of liquid which are sprayed through the heated nozzle. This effectively removes the water from the solution, leaving a dry powder. Particles will remain in the spray-dryer for up to two minutes and are exposed to temperatures up to 90 C while they remain in the dryer. Spray-drying effectively reduces microbiological contamination of starting materials. Of course, when highly contaminated products are dried, spray-drying (like pasteurization) will only reduce and not eliminate microbial contamination.

*Colostrum* is the secretion from the udder of the cow immediately after parturition. Colostrum contains important immune components, including immunoglobulins, immune cells, hormones and growth factors in addition to nutrients such as vitamins, minerals, fat and protein. Feeding a minimum of four liters of colostrum in the first 24 hours of life is essential to ensure that calves are healthy and to minimize the risk of death due to disease.

Traditionally, we have viewed colostrum as a perfect food. It is not. Colostrum is known to transmit many different diseases from the dam to the offspring, including brucellosis, tuberculosis, Johne's disease and others. Therefore, we must critically evaluate the quality of colostrum – in terms of both the immunoglobulin content as well as the microbiological quality of the colostrum.

To date, pasteurization of colostrum has not been very successful. Many researchers have attempted to pasteurize colostrum. However, when colostrum is heated to 63 C for 30 minutes, there is a dramatic reduction in the immunoglobulin content of colostrum. Heating to 72 C for 15 seconds may be less damaging than “batch” pasteurizing, but it also reduces the immunoglobulin content. This puts the calf at risk for disease and death. In addition, many of the proteins in colostrum are heat sensitive and pasteurization may coagulate inside the pasteurizing equipment.

*Colostrum supplements and replacers* have been introduced into the market in the past several years. The technology used in manufacturing these products has improved dramatically, and there are products

available that can effectively replace colostrum by providing >100 grams of IgG per dose. The product, Acquire (APC, Inc., Ames, IA, USA) has been fed to calves and lambs as the sole source of immunoglobulins with great success. In all experiments, the IgG fed to calves were effectively absorbed into the bloodstream and provided passive immunity to the calf. Because the mass of IgG fed is held constant, there are usually fewer calves with failure of passive transfer compared to calves fed maternal colostrum.

*Waste milk* is the milk that cannot be sold due to the presence of antibiotics or contamination due to bacterial or viral infections in the animal. Waste milk is commonly used to feed dairy calves. Commonly, waste milk is pooled into larger lots and then administered. The milk may be left for several hours prior to feeding, which effectively incubates the organisms in waste milk, making the risk of contamination much greater.

Both brucellosis and tuberculosis may be transferred through contaminated milk. When cows are infected with either of these diseases, there is a significant risk of transmitting the disease to the offspring. Worse still, if waste milk is pooled and then fed to all calves, there is a much greater risk of transmitting the disease to all calves. Therefore, if either brucellosis or tuberculosis (or other disease) is present in the herd, waste milk should not be fed to calves. In these cases, it is far preferable to feed calves milk replacer, which is not a risk of transmitting either brucellosis or tuberculosis.

Waste milk may be pasteurized to reduce the risk of infection. However, it is important to remember that the starting number of organisms in the milk and time of processing will determine the overall risk of contamination and subsequent risk of infection. When milk is highly infected, even pasteurized milk may pose a risk of infection. It is important to remember that pasteurization will only reduce – and not completely eliminate – the microbial contamination of milk. Further, continued monitoring and testing of equipment is essential to make sure that the waste milk is effectively pasteurized. It is very common in the U.S. for farmers to install equipment, only to find that over time the pasteurizers need constant monitoring to make sure they continue to work properly.

*Commercial milk replacers* are products containing whey proteins, lactose and other ingredients. Products obtained from respected companies use high quality ingredients with superior quality control. The combination of processing of proteins, tight quality control and the ability to economically process proteins makes milk replacers a very important component of any disease eradication program.

## **Recommendations**

When brucellosis or tuberculosis are concerns on a dairy farm, it is important to work closely with government officials and veterinarians to establish an eradication plan for the herd. A comprehensive plan is the only effective way to eliminate the disease from the herd. One important component of any plan is to reduce the risk of transmission is to eliminate the transmission of disease by utilizing milk replacer and colostrum supplements as appropriate. Commercial products have been processed through pasteurization and/or spray-drying to eliminate the risk of transmission of disease.

#### USING COMMERCIAL FEEDS TO REDUCE THE RISK OF DISEASE:

1. Remove the calf from the dam as soon as possible after birth. Minimize the contact between calf and cow, since the cow can be a source of infection for the calf
2. Place the calf in a clean, dry pen that has been properly sanitized. This is **CRITICAL**. Placing a calf in a soiled, dirty environment can defeat all other control measures.
3. Feed colostrum (2 to 4 L) as soon as possible. Make sure that the colostrum used comes from test negative cows. If there is any question, **DO NOT USE THE COLOSTRUM**.
4. If needed, mix a high quality colostrum supplement or replacer with clean water. One feeding is usually 400 to 500 g of product in 2 L of water. Mix well and feed the calf using a clean nipple and bottle. Repeat at 8 to 12 hours of age.
5. Commercial milk replacers are an excellent alternative to whole or waste milk. Use a good quality (20/20 minimum) with minimal inclusion of vegetable proteins. Feed according to label directions.
6. Offer clean, high quality calf starter and water from 2 d of age. Wean the calf when it is eating at least 2 lbs. (1 kg) per day for two consecutive days.

**Written by Dr. Jim Quigley (09 September, 2002)**  
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