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Cold Stress and Newborn Calves

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Calf survival in northern climates is made more challenging by cold environmental temperatures around the time of birth. The USDA estimates that 95,000 calves die each year due to cold stress and hypothermia.

Cold environmental temperatures compound all of the other challenges to calf survival. Cold stress can be impacted by several factors such as: dystocia, cow nutrition during gestation, as well as colostrum intake by the calf. Understanding how to manage cold stress in newborn calves can help producers improve calf survival.

Cold Stress in the Newborn Calf

The lower critical body temperature can be defined as the temperature at which the animals' nutrient requirements to maintain homeostasis are increased due to cold stress. In other words, the lowest environmental temperature the animal can withstand before additional energy is needed to for warmth and proper body function. For newborn calves, these temperatures are impacted by age (Table 1), and environmental factors such as moisture in the hair coat and wind.

While the identification of a cold-stressed calf is often not a challenge, producers can benchmark the severity of the cold stress.

Rectal temperature is the most accurate method of determining if a calf is experiencing hypothermia. There are two types of hypothermia that newborn calves experience: exposure and immersion. Exposure hypothermia occurs when a steady loss of body heat is experienced in a cold environment. This is due to respiration, evaporation, and insufficient body condition, weather protection, and hair coat. Immersion hypothermia is defined as the rapid loss of body heat as a result of a wet, saturated hair coat in a cold environment. This most commonly is seen directly following birth.

Hypothermia

Mild hypothermia is present when the calf's core body temperature drops below 100°F. Signs of mild hypothermia include: shivering to increase heat production, increased pulse (over 70-100 beats per minute) and increased breathing rate (over 20-40 breaths per minute), cold nose, and pale cold hooves. These are the early signs that blood is being directed away from the extremities to the core of the body. In addition, behavioral symptoms may be seen such as confusion and clumsiness.

Hypothermia is classified as severe when the body temperature drops below 94°F. At this point the body will continue to direct blood flow to the core of the body. Paleness of the mucous membranes results from diminished oxygen supply to the external tissues. As body temperature continues to drop, the body continues to shunt blood away from the extremities. This allows acid metabolites to build up in the muscle extremities resulting in rigidness of the limbs and muscles.

At 94°F, the vital organs will begin to cool. This

includes the brain, resulting in impaired motor function. Once the calf's core body temperature drops to 88°F, the pulse and respiration will slow. As core body temperature drops below 86°F, signs of life are hard to detect. Pupils are fixed and dilated and the pulse may be undetectable. Occasional gasps for air may be the only signs of life.

Preventing Cold Stress in the Calf

Cow Nutrition

Good cow nutrition during late gestation is essential to good health of the calf at birth. Protein, energy, and supplemental fat all play a role in getting the calf off to a good start.

Cows fed an adequate energy diet have more calves born alive than cows fed a restricted energy diet (100% vs. 90%, respectively). Calves from cows receiving restricted energy diets could produce less heat than calves from cows fed an adequate energy diet. Crude protein consumption the last 60 to 90 days of gestation is a key area for improving calf survivability. In one study, feeding crude protein at a rate of 2 pounds per head per day eliminated the incidence of weak calf syndrome.

Fat supplementation for the cow has been shown to improve the newborn calf's response to cold stress by increasing glucose concentration in its blood. It is believed that this increased substrate is available for heat generation. There is also some indication that serum immunoglobulins in calves of fat-supplemented cows are higher than non-supplemented cows.

It is a misconception that reducing the plane of nutrition prior to calving will reduce dystocia. Research has clearly demonstrated that reducing the cow's plane of nutrition prior to calving may reduce calf birth weight, but it does not reduce dystocia. It may, in fact, reduce calf survival and increase occurrence of scours.

Colostrum

Colostrum provides the calf with its first mechanism against infectious agents. Contained in colostrum are various immunoglobulins and other substances which provide the first immunity against infectious agents the calf is exposed to. Levels of fat and protein are also significantly higher in colostrum compared to milk. The calf's first meal of colostrum, therefore gives the calf critical nutrients for it to use in maintaining his body temperature in those first critical hours of life.

The calf's ability to absorb the antibodies contained in colostrum decreases rapidly with age. This is why calves should consume colostrum as soon as possible after birth. It is recommended that calves consume their full dose of colostrum within the first 6-12 hours following birth, in order to maximize antibody absorption by the calf. In general, two quarts of colostrum should be administered 2-3 hours after birth, with the remaining 2 quarts 4 to 6 hours later. The amount of antibodies contained in colostrum quality will vary from animal to animal, with cow colostrum containing a higher concentration of antibodies than that from heifers. Colostrum from beef cows will be more concentrated in those from dairy cows. In some cases it may be necessary to utilize commercial colostrum supplements or replacers.

Managing Environmental Stress

Wet, cold weather can be rough on calves born in winter and early spring. Wet and cold calves are more prone to cold stress or hypothermia. Precipitation adds to the negative effect on calf survival when temperatures drop. Just as in mature animals, maintaining a dry hair coat is critical for the animal's ability to stay warm. When the hair coat becomes muddy or saturated with moisture, it loses its ability to insulate the animal. At this point a dramatic increase in the amount of heat being lost will occur due to evaporative cooling. This loss will be elevated with any wind that is present. Newborn calves will spend 73-81% of their time lying down. Thus, providing clean, dry areas for calves to lie out of the wind becomes critical to the newborn calf's ability to keep its hair coat dry, and allow for maximum insulation of body heat.

Treating Cold Stress in the Calf:

Calf warming "coats" or blankets may be utilized to help a calf maintain its body temperature. The blankets may need to be changed to maintain a consistent temperature.

A hot box or warming box is another tool that may be utilized to warm calves. Commercial warming boxes may be purchased, or homemade boxes may be

constructed. Regardless of whether it is a commercial or homemade unit, considerations of temperature regulation, ventilation, and sanitation are important.

Temperature

An ideal temperature for a warming box environment is 105-108°F. Higher temperatures put the calf are risk for burns.

In addition, some type of venting is necessary to prevent buildup of carbon monoxide and moisture, since moisture buildup could serve to cool the calf back down.

Air movement, such as from a fan, will help ensure that heat is evenly distributed to the calf, and will prevent hot spots in the warming box. Thermostatic control is convenient to help maintain consistent temperatures in the box.

Sanitation is also important to prevent the spread of disease between calves using the warming box. The box must be cleaned and disinfected between uses, otherwise organisms such as e. coli or Salmonella will proliferate on the inside surface of the box, creating the potential to cause disease in the calf.

Water baths

Warm water baths may be used to warm a chilled calf if the calf's head can be supported sufficiently out of the water. The water should be gradually warmed to 100°F, and then adjusted with more warm water to keep the temperature at 100°F. Close supervision is needed while the calf is in the water bath to avoid drowning.

Whichever means is utilized to warm the calf, the calf should be warm and stable for a period of time before it is returned to the cow. The calf should be monitored closely over the next several days and weeks, since it may be more susceptible to disease challenges such as scours and pneumonia.

Summary

Calves born during cold weather conditions, especially following a difficult calving, are particularly susceptible to cold stress and decreased survivability (Figure 1). Prevention methods including adequate nutrition for cows, appropriate intervention when a cow is having difficulty calving, and ensuring that newborn calves receive adequate colostrum in a timely manner will help improve the chances that calves will thrive despite cold weather conditions. Recognizing signs of cold stress, and promptly and appropriately intervening to warm a chilled calf, will also improve survival rates substantially.

Figure 1: Factors impacting cold stress on newborn calves.

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