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Production Improvement in Livestock by Cold Stress Management

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Introduction

When temperatures start to decline in winter than its effect on growth of calves, heifers and cows productivity. Cows are warm-blooded and need to maintain a constant core body temperature. The normal rectal temperature for a cow is 38°C (101°F). Animals kept within a range of environmental temperatures known as the thermo neutral zone (TNZ). Temperatures below the lower end of this range, the lower critical temperature, result in cold stress in cows. Cold stressed cows increase their metabolic rate to supply more heat. However, this increases dietary requirements, particularly energy. Hypothermia occurs when body temperature drops well below normal. As hypothermia progresses, metabolic and physiological processes slow down, blood is diverted from the extremities to protect the vital organs. Teats, ears and testes are prone to frostbite. In extremes, respiration and heart rate drops, animals lose consciousness and die. Calves needs more attention because it is more susceptible to the negative effects of cold temperatures than are cows and more mature heifers. Calves are especially susceptible to the negative effects of cold due to having a larger surface-area-to-body-mass ratio than more mature animals, resulting in more body heat loss with the larger surface area. The first goal is to meet the increased energy requirement for maintenance during cold stress and secondly to provide enough energy above maintenance requirements to keep calves growing at a rate of at least 1.0 to 1.5 pounds per day. Jersey calves have a maintenance energy requirement 15% greater than large breed calves. In more mature animals, fat can be mobilized to make up for this energy deficit but calves are born with low body fat reserves and excess energy must be supplied to avoid negative

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consequences. The range of temperatures where calves use no additional energy to maintain body temperature ranges from about 55˚F-70˚F, varying slightly due to age and other factors. In general, for every 1°F drop in temperature below the TNZ maintenance requirements of the animal increase by 1 percent. The more noticeable consequences of cold stress on calves are the decreased average daily gains this is because most of supplemented energy used for growth in TNZ conditions will be used for maintenance. Calving season has an impact on energy requirements in late gestation because in coldest time their energy requirements will be more difficult to meet results greater risk of losing weight if they cannot meet their energy requirements. When calves are not growing or losing body weight, then the start of first lactation is being delayed and potentially being compromised. A summary of calf data from Cornell found that a difference of 2.2 lbs. daily gain in the pre-weaning period resulted in 1,874 pounds more milk in the first lactation, and the trend continued in later lactations. Nutrition and management are the keys enabling calves to grow during cold stress, resist digestive and respiratory disease and minimize stressors. When feeding calves during cold stress, one goal is to provide adequate amounts of energy from fat and lactose whereas priority use of protein should be for muscle and bone growth. Increase caloric intake from milk such as additional fat supplement requires for overcoming the cold and fulfill the energy requirement. Besides microbial fermentation produces a large amount of heat which is an important ally for cold stressed calves.

Table 1 Types of Hypothermia

30-32°C (86 – 89°F)	**22-29°C (71 - 85°F)**	**Below 20°C (68°F)**
Mild hypothermia	**Moderate hypothermia**	**Severe hypothermia**

Effect of cold stress

1. Calves under cold stress will not grow as well as calves do in the thermo neutral zone (TNZ) even a slight loss in growth can be detrimental to future productivity.

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2. Calves are especially susceptible to the negative effects of cold due to having a larger surface-area-to-body-mass ratio than more mature animals, resulting in more body heat loss with the larger surface area resulted during cold stress energy to be used for maintenance rather than being utilized elsewhere in the body.
3. New born calves in late winter still be extreme weather conditions can be especially at risk for hypothermia.
4. The management of the heifers during the winter months will be important in achieving the goals heifers to calve at 22 to 24 months of age at about 90% of their mature weight. Heifers need to average about 1.7 lb/day of growth for large breed calves or 1.3 lb/day for small breed calves to reach the desired breeding size at 13 months of age.
5. Respiratory problems increase in calves and heifers in the winter because the housing allows inadequate or excessive air exchange.
6. Feed costs increase in winter for all cows but are even higher for thin cows as they need to gain weight during the winter to ensure trouble free calving and low calf mortality. Cows that need to gain weight from a body condition score (BCS) of 2 to 3 during winter will require an extra 1,600 lbs of hay and 900 lbs of corn.
7. When cold stress occurs due to frigid temperatures, cows may exhibit muscle shivering, an increased heart rate, deeper breathing and an increased metabolism rate.
8. Hypothermia occurs when body temperature drops well below normal. During hypothermia progresses, metabolic and physiological processes slow down, blood is diverted from the extremities to protect the vital organs. Teats, ears and testes are prone to frostbite. In extremes, respiration and heart rate drops, animals lose consciousness and die.
9. For every one degree drop below the cow's critical temperature, a cow's energy requirement (TDN) increases 1 percent.

Factors affecting animal's ability to withstand the cold

1. **Acclimate.** Cattle do adjust or acclimate to colder weather by growing a longer thicker coat. This provides additional insulation against cold weather. The coat must be clean and dry to provide maximum protection to the cow.

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2. **Fat layer.** Cattle in good condition with a good fat layer are able to withstand the cold better than thin cattle.
3. **Metabolic rate.** Cows will also increase their metabolic rate to increase heat production and help maintain body temperature. This usually increases appetite as well and cows eat more.

Key management factors to limit the effects of cold stress

1. **Reduce wind speeds to increase animal comfort.** Wind markedly reduces the effective temperature, increasing cold stress on animals. During cold stress need to factor in both the actual temperature and the wind speed to determine the effective temperature. For preventing any kind of available protection, whether natural or man-made, can be very valuable in reducing the amount of wind chill.
2. **Cows' energy needs increase as the temperature drops.** For every degree that the effective temperature is below the lower critical temperature than the cow's energy needs increase by 1%. Provide additional feed more hay and grain. If wet feeds are fed, make sure they are not frozen.

Table 2 Effective temperature and the additional feed required to meet the cow's energy requirements

Effective Temperature (°C)	Extra energy required (%)	Extra hay required (lbs/cow/day)	Extra grain required (lbs/cow/day)
-1	0	0	0
-12	20	3.5-4	2-2.5
-23	40	7-8	4-5

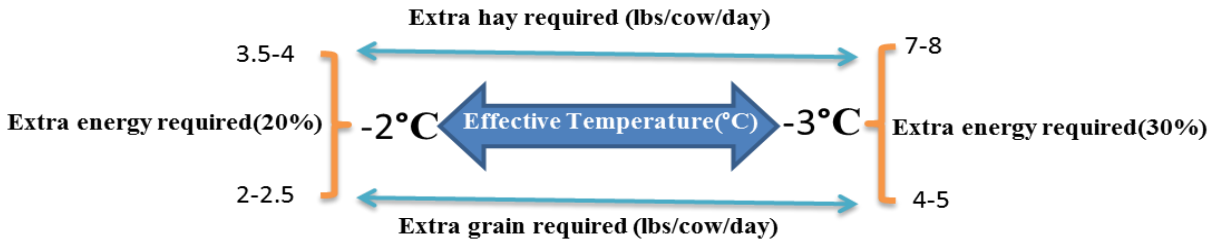

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Fig 1 Additional feed required to meet the cow's energy requirements

3. **Feed an Ionophore such as Rumensin to beef cows.** This will help improve feed utilization cows derive more energy from the ration. This is particularly important as cow's energy requirements increase and / or they are fed poorer quality hay. The animal's entire metabolism system increases in activity. Also, the passage rate of roughages through the rumen and digestive tract increases. These changes trigger an increase in the cow's appetite and voluntary intake."

4. **Provide water.** Regarding changes in feed intake in response to cold stress and the cow's need for more energy. If water availability is restricted than feed intake will be reduced. If the feed availability is limited, either by snow cover or access to hay feeders there for requirement of energy providing larger amounts of high-concentrate feeds.

5. **Sort off thin cows for more specialized care.** Sorting off thinner cows to a separate area for provide them with a higher quality ration while eliminating competition from other cows because it is important to supplement those forages appropriately to meet animal requirements. Nutrient requirements go up throughout the third trimester and early lactation, so cows that are thin right now will need a high plane of nutrition to keep up with fetal growth, milk production.

6. **Do not close eave inlets.** This will restrict the ventilation rate and create wet, damp conditions.

7. **Special care of calf.** Health during cold stress can be a major challenge. Be sure to maintain best management practices of feeding adequate amounts of colostrum, dipping the navel at least twice, drying calves thoroughly with towels, and keeping the environmental temperature above 50°F for newborns during the first 48 hours. If the ground has frozen and the calf is less than three weeks of age, then the calf must have a calf jacket.

8. **Use ample amount of good, dry bedding.** Having dry teats when the dairy animal leaves the parlor is important. One way to lessen the risk is to dip the teats, allow the dip of about 30 seconds and then blot dry using a paper towel. Provide adequate dry bedding which makes a significant difference in the ability of cattle to withstand cold stress.

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9. **Keep cows clean and dry.** Wet coats markedly reduce the insulating properties and make cows more susceptible to cold stress.

Conclusion

Deviation of temperatures from TNZ animal feel stress when temperature below the lower limits feels cold stress whereas when temperature rises upper limits of TNZ than animal feel stress in both alter metabolic activity which effects on growth of calf and heifer as well as production of lactating animal besides pregnant. The energy requirement increases of calves, heifers, pregnant cows and lactating animal during cold stress for maintaining normal body temperature. Calves require more maintains energy in comparisons to heifer and cows this is because larger surface-area-to-body-mass ratio than more mature animals and susceptible to the negative effects of cold due to having a, resulting in more body heat loss with the larger surface area. Cold stress causes calves" energy to be used for maintenance rather than being utilized elsewhere in the body therefor increase caloric intake from milk as well as additional fat supplement requires for overcoming the cold and fulfil the energy requirement. Besides microbial fermentation produces a large amount of heat which is an important ally for cold stressed calves. When calves are not growing then the start of first lactation is being delayed and potentially being compromised. Calving season has an impact on energy requirements in late gestation. If late gestation overlaps with the coldest time of the year, then it will be more difficult to meet their energy requirements. These cows are also at greater risk of losing weight if they cannot meet their energy requirements.