Dairy Feeding and Management Considerations during Heat Stress

Cooperative Extension Service

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Introduction

Heat stress results in decreased milk production, reproductive performance, and immune function in both milking and dry dairy cows. Both environmental temperature and humidity impact the amount of heat stress that dairy cows undergo. Recent research has shown that milking dairy cows start to decrease milk production when the temperature-humidity index (THI) exceeds 68 (i.e., temperature of 72°F with 45% relative humidity, or 80°F with no humidity) and not 72 as shown in previous research with lower-producing dairy cows. The detrimental effects on the estrus expression, conception rates, and early embryo survivability occur before declines in milk production are observed and may occur at a temperature-humidity index as low as 55 to 60. Generally, the maximum declines in milk production as a result of heat stress are not seen until 36 to 48 hours after the initial heat stress event. Older dairy cows seem to be more severely affected compared to younger cows, and not all cows respond to heat stress in a similar manner.

Dry cows also are negatively affected by heat stress. Heat-stressed dry cows produce 1,000 to 2,000 pounds less milk during the next lactation. In addition, fetal growth is reduced because of reduced blood flow to the uterus, resulting in a decreased supply of nutrients for the rapidly developing fetus. These effects result in smaller calves being born to dams subjected to heat stress during late pregnancy. Thus, proper management practices, facilities, and, to a lesser extent, nutrition are needed to mitigate the effects of heat stress not only in milking dairy cows but just as importantly in dry cows.

Environmental Management

To maintain normal metabolism, a cow's core body temperature needs to remain relatively constant. In addition, core body temperature must be slightly higher than the ambient temperature to allow heat to be transferred to the external environment. Heat is generated from the digestion of feeds and nutrient metabolism. When dairy cows are subjected to increased environmental temperature and/or humidity outside their thermal neutral zone, the cow's environment must be cooled to allow this heat exchange between the cow and her environment to occur and to prevent, or at least minimize, increases in a cow's core body temperature. By providing dairy cows shade, increased ventilation, and cooling of the surrounding air by fans alone or in combination with sprinklers, dairy cows are better able to minimize the detrimental effects of heat stress on milk production, reproduction, and their immune system.

Some key points to remember include:

- Fans over freestalls, in the housing area, and over feed bunks should be automatically programmed to turn on when the temperature and humidity reach a THI of 68 (i.e., temperature of 72°F with 45% relative humidity, or 80°F with no humidity).
- In more humid climates, fans should be used in combination with sprinklers (nozzles need to deliver 0.5 gallon/minute of water, 20 to 40 pounds/square inch of pressure [psi]) which will wet the hair coat of cows. Sprinklers should generally be on for 1 to 3 minutes, then off for the remainder of a 15-minute cycle. The length of time sprinklers run increases with increasing temperature. Fans should run continuously. (Janni, University of Minnesota Engineer)
- Fans and sprinklers (in humid environments) should be used in the holding pen to cool cows waiting to be milked, and time in the holding pen should be kept to a minimum.
- Adequate number of fans should be spaced at about 12 feet high along the length of the freestall barn. The recommended distance between fans is 30 feet for 36-inch fans and 40 feet for 48-inch fans (Gay, Virginia Tech Extension Engineer).
- Check fans to make sure they are angled correctly (20-degree angle) and are operating properly. Fans also should be cleaned regularly.
- Minimize cow movement, and work dairy cows and heifers during the coolest part of the day.
- If facilities housing far-off and close-up dry cows do not allow for cooling, an hour in the holding pen with fans and sprinklers operating will help cool dry cows. However, cooling dry cows continuously is more effective.

Heat Stress Modifies Cow Behavior

Dairy cows experiencing even mild heat stress spend more time standing compared to cows not experiencing heat stress. This change in cow behavior is most likely related to the cow's attempt to increase the amount of surface area needed to dissipate heat and decrease her core body temperature. Although there has not been a research trial looking at the direct impact of heat stress on incidence of lameness, we do know: (1) as cows spend less time lying down and more time standing, the incidence of lameness increases and (2) heat-stressed cows spend more time standing. Thus, one could assume that heat-stressed cows would have a higher incidence of lameness, and any practices that reduce heat stress and standing times of dairy cows would likely decrease the proportion of dairy cows becoming lame.

Separate studies have shown an increased incidence of lameness during the summer. Besides heat stress, the type of bedding used in freestalls (i.e., sand versus different types of mattresses) and wetness of the feed bunk area as it relates to drainage of water from sprinklers also may affect the incidence of lameness.

Dairy cows seek out areas that have a lower ambient temperature. This behavior seems very intuitive but may readily explain why certain areas of a housing facility are better utilized during the summer or the hottest part of the day. Sometimes incorrect fan placement or operation, lack of natural ventilation, or north-south orientation of a barn (allowing sun to enter) create sections of the barn that are not as cool as other areas, thus limiting their use.

Feeding Behavior Modifications with Heat Stress

Water intake: Water intake increases dramatically in dairy cows under heat stress as a means to dissipate heat to the environment. When environmental temperatures increased from 64° to 86°F, water consumption was shown to increase by 29%. Thus, providing plenty of cool, clean water is critical upon return from milking and within their respective housing. Routinely, waterers should be emptied and scrubbed with a brush and chlorine solution. Providing shade for waterers for heifers and dry cows is also critical in maintaining water intake.

Dry matter intake: Dry matter intake drops under heat stress with a corresponding drop in milk production. However, only 50% of the drop in milk production can be explained by decreases seen in dry matter intake. The remaining drop in milk production is associated with changes in metabolism and the responsiveness of various tissues and organs to normally produced hormones. This does not mean that instituting practices to maintain feed intake are not important (click here for more information); they are important and will help maintain or attempt to optimize nutrient intakes at a critical time. Feed should be mixed more often in the summer or an additive (i.e., buffered propionic acid products) incorporated into the TMR mix to extend bunk life and prevent feed from excessively heating in the feed bunk. Dairy cows generally consume more feed over the nighttime hours when environmental temperatures are lower.

Increased maintenance requirement for energy: With the increase seen in respiration rates and panting with heat stress, energy needed for maintenance increases by 7% to 25%, or 0.7 to 2.4 Mcal NEL/day. This increase in energy requirement equals the amount of energy needed to produce 2.2 to 7.5 pounds of milk (3.7% butterfat). Thus, helping dairy cows thermally regulate their body temperature is very important when trying to maintain milk production.

Modifying Diets for Heat-Stressed Dairy Cows

Maintaining effective fiber intake: Adequate effective fiber is necessary for maintaining rumination, buffering the rumen contents, and efficiently digesting forages and grain components of the diet. Heat stress increases the rate of respiration and panting, decreases rumination time, and results in a decrease in the amount of saliva and bicarbonate in the blood. These changes result in a decreased buffering of the rumen contents and blood. Thus, decreasing the fiber content and increasing the amount of starch in a diet is the last change you want to make in an attempt to increase the energy of the diet because ruminal acidosis could result. However, feeding excessive amounts of neutral detergent fiber (NDF) to dairy cows under heat stress is detrimental. High NDF forages are generally lower in forage quality and result in more heat of fermentation when digested in the rumen, and thus the dairy cow needs to dissipate more heat compared to consuming diets with adequate amounts of fiber.

Feeding highly digestible forages: Feeding higher-quality forages increases the energy content of the diet, helps maintain adequate rumination, and decreases the heat of fermentation associated with feeding lower-quality forages. Brown midrib forages (i.e., corn silage or forage sorghum) may be more beneficial in diets of heat-stressed dairy cows to improve digestibility of the fiber and, therefore, the amount of energy derived from the consumed diet.

Adding fat to the diet: Adding fat to the diet is expected to decrease heat produced during the digestion of feeds while increasing the amount of energy available. Studies where fats have been fed to heat-stressed cows have shown inconsistent responses in improving milk production; some have improved milk production, and others have shown no response.

Adding yeast cultures to diets: Yeast culture has been shown to improve fiber digestion and stabilize the rumen environment. In heat-stressed dairy cows supplemented with yeast, lower rectal temperatures and respiration rates were observed in several but not all studies. Several studies, but not all, have shown an increase in milk production of heat-stressed cows supplemented with yeast. In 1994, Huber and others summarized 14 lactation comparisons with 823 heat-stressed cows where yeast was or was not added to the diet. Overall, these comparisons showed a 2.2 pound/day increase in milk production with yeast supplementation with six comparisons showing significantly higher milk production with supplementation, three slightly higher, and the remaining five comparisons with no or slightly lower milk production. Two recent studies have shown no improvements in milk production with yeast supplementation, but one indicated improved feed efficiency. Early-lactation cows fed a higher proportion of concentrate may respond more favorably to yeast supplementation than mid- to late-lactation cows.

Modifying mineral content of the diet: Heat-stressed dairy cows sweat, and their sweat contains high amounts of potassium and sodium, thus increasing their need for these minerals in summer rations. To achieve these increased concentrations of potassium and sodium and maintain adequate dietary cation-anion difference (DCAD), additional amounts of sodium bicarbonate, potassium carbonate, or both may need to be added to the diet. In addition, higher amounts of potassium reduce the absorption of magnesium, thus increasing the requirements for magnesium.

Heat-stressed dairy cows should be fed adequate amounts of trace minerals and vitamins, particularly antioxidant nutrients. At this time, research trials where additional trace minerals or vitamins have been added to diets of cows under heat stress have not consistently shown a benefit. More research is needed before additional amounts and sources of trace minerals are recommended to be added to diets of heat-stressed dairy cows.

Rations for dairy cows should be formulated for dairy cows before heat stress occurs and should contain:

- 1.4% to 1.6% potassium
- 0.35% to 0.45% sodium
- 0.22% to 0.35% magnesium (readily available source)
- +25 to 30 or greater DCAD balance

Environmental and dietary modifications can help mitigate the effects of heat stress on dairy cows and should be implemented ***before the effects of heat stress are noticed***. These modifications are needed not only for the milking herd but just as importantly for the far-off and close-up dry cows. When making these modifications, one must realize that changes in the environmental temperature are the most important, with dietary modifications serving a supportive role. By helping dairy cows dissipate the extra heat load, milk production, reproduction, and health can be maintained or at least the negative effects minimized and potential profitability realized during the spring, summer, and early fall months.