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HEAT STRESS AND EXERCISE INCREASE SALT REQUIREMENTS

Jerry W. Spears, Ph.D.
North Carolina State University

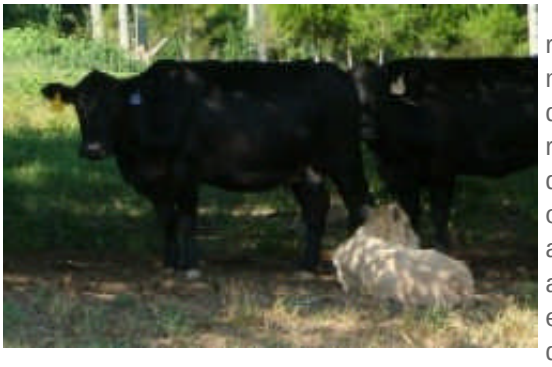
INTRODUCTION

We are in the middle of summer and many parts of the United States are experiencing record high temperatures. It is important to recognize that humans are not the only creatures that suffer from heat. Animals are also affected by heat stress. Heat stress in animals results in depressed feed intake and production (growth, milk production, egg production, etc.) and may even cause death in some instances.

Regulation of body temperature within a fairly narrow range is critical for survival of humans and most animals. Normal metabolism in the body results in the generation of heat. The temperature of the body is controlled by processes that cause heat to be retained or dissipated from the body. When the environmental temperature is high, heat must be lost or dissipated from the body for body temperature to be maintained in the normal range. Most animals rely on sweating (humans, cattle, horses) or panting (poultry, dogs, swine, sheep) to dissipate heat and cool the body when environmental temperatures are high. Panting refers to a rapid shallow breathing which increases the amount of water vaporized in the mouth and respiratory passages. High environmental temperatures increase losses of electrolytes, such as sodium, chloride, and potassium in sweat, and therefore can increase requirements for these minerals. Increasing the level of salt in the diet of some animals may also alleviate some of the adverse effects of heat stress.

Exercise will also increase sweating and the effect of exercise on mineral requirements is often ignored. Exercise in horses greatly increases sweat losses of sodium, chloride, and potassium. Exercising horses in the summer when environmental temperatures are high will further increase sweat losses. This newsletter will discuss the effect of heat stress in various animals and exercise in horses on salt requirements.

HEAT STRESS IN CATTLE



Cattle increase sweating and respiration rates during heat stress in an attempt to maintain their body temperature. In lactating dairy cows heat stress is associated with reduced feed intake and milk production. Slight decreases in feed intake of dairy cows usually occur at ambient temperatures of 77 to 81° F, and more dramatic depressions in intake are apparent when environmental temperatures exceed 86° F (Sanchez et al., 1994). Lactating dairy cows require approximately 0.22% sodium and 0.20% chloride under non- heat stress conditions (NRC, 2001). Most of the sodium and chloride required by cows under normal conditions is secreted in milk. However, the NRC

(2001) estimates that when environmental temperatures are 86° F or greater an average size dairy cow will lose an additional 3.5 grams of sodium (9 grams of salt) per day in sweat. In a study conducted during the summer at the University of Florida, increasing the sodium (from either salt or sodium bicarbonate) level in the diet from 0.18 to 0.55% increased feed intake and milk yield (Schneider et al., 1986).

Heat stress in beef cattle can reduce feed intake, weight gain, milk production, and in extreme cases cause death. For example this year in Kansas a number of feedlot cattle have died as a result of heat stress. Salt requirements of beef cattle are higher under tropical or hot, semi-arid conditions due to large losses of water and salt occurring via sweat (McDowell, 2003). Cattle grazing forages often consume forages that are high in potassium, and high intakes of potassium can also increase salt requirements. Forages grown in most areas are deficient in sodium. Therefore, it is especially important not to let cattle run out of salt or a salt containing mineral supplement during the summer.

HEAT STRESS IN POULTRY

Birds are particularly susceptible to heat stress because they are not able to sweat because of the absence of sweat glands. When the temperature and relative humidity exceeds the comfort level of birds they loss their ability to effectively dissipate heat. This causes birds to decrease their feed intake in order to reduce their heat production. Heat stress in poultry also reduces growth rate, hatchability of eggs, and increases death loss.

Because birds are unable to sweat at high ambient temperatures they are more dependent on panting to dissipate body heat. Respiration rate can increase from 25 breaths per minute under normal conditions to over 250 breaths per minute when birds are exposed to acute heat stress (Teeter and Belay, 1996). The increased respiration rate results in a respiratory alkalosis (higher than normal blood pH) that results in losses of sodium and potassium from the body. Deyhim and Teeter (1991) showed that adding 0.39% sodium chloride to drinking water of heat stressed broilers reduced death losses from 12% in controls to 7%. Water consumption was 35% greater in broilers receiving sodium chloride-treated water than in birds receiving normal water. The greater water consumption may explain the higher survivability of broilers consuming sodium chloride-treated water during heat stress. Adding 0.5% potassium chloride to drinking water in this study appeared to be more effective than adding 0.39% sodium chloride in alleviating heat stress (Deyhim and Teeter, 1991). However, potassium chloride is considerably more expensive than sodium chloride.

Recent research suggests that sodium and chloride requirements of broilers are higher than NRC (1994) recommendations. According to the NRC, broilers from 1 to 21 days of age require 0.20% sodium and 0.20% chloride. Murakami et al. (1997) found that young male broilers required 0.25% sodium and 0.20% chloride for maximum 21-day body weights. More recently, Oviedo-Rondon et al. (2001) reported that broilers from 1 to 21 days of age required 0.28% sodium and 0.25% chloride for optimal performance. Under subtropical summer conditions in Pakistan, broilers required 0.25% sodium and 0.30% chloride for maximum performance (Mushtaq et al., 2005).

SODIUM NEEDS OF EXERCISING HORSES

Horses are used by humans for a number of activities such as recreational riding, racing, ranch work, and rodeos. All of these activities involve work or exercise of varying intensities. Horses sweat profusely during intense exercise, and high environmental temperatures will further increase sweating. Sweat from horses contains 4 to 5 times more sodium and chloride than sweat from humans (Lewis, 1995). Thus, the salt requirement of horses is greatly affected by their level of work and environmental temperature.

The Nutrient Requirements of Horses (NRC, 2007) for work are divided into four categories (light, moderate, heavy, and very heavy) based on exercise intensity. Horses used for recreational riding would fall into the light or moderate exercise category, while Quarter horses and Thoroughbreds used for racing would be in the very heavy exercise category. Sodium requirements are 40, 78, 155, and 310% greater for horses doing light, moderate, heavy, and very heavy exercise, respectively, compared to the adult horse with a sedentary lifestyle (NRC, 2007).

Salt deficiency in horses, caused by sweating, results in fatigue, dehydration, exhaustion, and muscle spasms and cramps (Cunha, 1991). One should not assume that the grain mix fed to exercising horses will meet their salt requirement. Salt should be available free choice to horses at all times. When salt is provided free choice horses consume sufficient quantities to meet their requirements for sodium and chloride. Salt can be provided in loose form or as a salt block. Consumption of salt is usually greater when offered as loose salt. The amount of salt consumed per day by horses will vary depending on activity level and ambient temperature as well as a number of other factors. A study conducted in the 1920s measured the salt intake of work horses during the hot summer months. Daily salt intake per horse was 0.64 ounces in May and increased each month to a high of 3.18 ounces per horse in August (Cunha, 1991).

SUMMARY

It is important to supply animals with adequate amounts of salt during hot weather. During heat stress conditions cattle sweat and increase their respiration rate resulting in considerable losses of sodium, chloride, and water. Poultry respond to heat stress by panting or increasing their respiration rate. The increased respiration rate in poultry results in a higher than normal blood pH that causes increased losses of electrolytes from the body. Adding salt at low levels to drinking water has reduced death losses in broilers exposed to acute heat stress. The salt requirement of horses is greatly affected by their level of activity (exercise) and the environmental temperature. Horses sweat profusely during intense exercise and this causes major losses of sodium and chloride. A source of salt should be available free choice to horses at all times.

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703-549-4648 - saltandtraceminerals@saltinstitute.org