Equine Exercise Physiology Study of

Problems of Heat Generation in the Three-Day Event Horse

by Pat Maykuth

Although the original intent of the Equine Exercise Physiology Study was to define and understand the physiological stressors associated with cross-country, several compelling related findings have resulted. It is safe to say that a horse is very efficient at ridding itself of heat given its body density. Density means the amount of body mass to skin surface. The horse has quite a lot of density to surface area—appearing five to six times denser than a human. The larger the ratio of muscle mass to skin surface, the more problems an animal has getting heat from inside that mass to the skin surface and dissipated.

The horse (like the human) cools in two basic ways: (1) heat is carried to the skin surface and removed from the body by evaporation or radiation, and (2) a third of the heat is removed from the blood stream in the lungs and exhaled. Cooling through evaporation is most common in warm temperatures. The horse is capable of providing enough sweat to cool itself even during mild dehydration. Unfortunately when a horse dehydrates even mildly (3-5% of total body water), circulation to the skin surface decreases and heat does not get moved from the muscle to the skin surface efficiently. Yet the horse continues to produce copious amounts of sweat which continues the dehydration process without solving the problem of moving heat to the surface.

When energy is burned for locomotion, 20% of the energy goes into moving the horse, and 80% is produced as heat. This is true of many animals and machines. Hence the elaborate cooling system in automobiles. If a horse is worked at the aerobic exercise heart beat of 140 beats per minute—which is a good trot, it will generate about 1% of heat per minute of work, which is a substantial amount of heat. And in general, horses do an excellent job of ridding themselves of this heat.

Weather factors may enhance or complicate heat dissipation. If the weather is breezy, air moving over the horse aids in evaporation and cooling. If it is a cool day, horses have no problem cooling. As the temperature rises, it is harder for a horse to radiate heat, or cool. It is evident that high heat hampers the horse, but with adequate hydration and cooling during the endurance phase, a three-day event can be run safely. The Olympic Games at Los Angeles and Barcelona are evidence that heat by itself can be dealt with. But when humidity becomes a factor, cooling becomes more difficult. Even at relatively cool temperatures, in the 50-60 degree range, a relative humidity of 90-100% has serious consequences. If the air is too saturated with water to evaporate the skin surface sweat, a horse's cooling ability is affected. In such cases, heat must be physically removed from the horse. A breeze will help. Also, as a horse trots or canters, the air moving over the horse aids in cooling. But, fast work also increases heat production.

Serious problems arise when a horse is unable to cool adequately for an extended period of time. The full endurance phase generally takes 60-90 minutes, when significant amounts of heat can be built up. In the presence of considerable heat and humidity a horse's ability to cool is severely compromised. Two years ago the FEI introduced a cautionary guideline for organizers and officials: When the combined ambient temperature in degrees Fahrenheit and relative humidity is 150, extra measures need to be taken. In these conditions a horse needs help cooling. Horses may be aided by:

- Using every available minute in the ten-minute box to cool your horse by covering his entire body with cold water and scraping off the hot water. Continue to do this until the water that runs off the horse is no longer warm. In summarizing research on cold water and tying-up syndrome, Dr. Catherine Kohn reported at the 1992 USCTA annual meeting that there is nothing in the entire research literature that relates the tying up syndrome with the use of water all over a horse's body. It appears that there is very little a rider can do in ten minutes to get a horse too cool. It should be noted that we are talking about using several dozen buckets of water to accomplish this heat reduction.
- The assistance area after B can be used to start the cooling process. Again, cool water is put on and scraped off and reapplied. The object of this process is to remove as much heat from the entire horse as possible. The same process is useful after D and should be continued until the horse's temperature goes below 101 degrees.

In our research we have found no ill effect on horses who remain in the box for more than ten minutes. When there are course holds or when riders come in early—more time has not shown a detrimental effect on competition performance or physiological responses. Further, given the information we have gathered on a horse's size—be it measured in height, weight, cannon bone circumference or a combination; larger horses work harder. In general, the bigger horses have higher pulses, higher temperatures and slower recovery rate in pulse, respiration and temperature. Bigger is not necessarily better physiologically. The larger the horse, the more difficulty it has cooling and the more attention the rider needs to pay to cooling. This is important not only in competition but also in training.

The EEP study is continuing its efforts to understand cooling through a series of studies planned for this summer that test the effects of a variety of cooling methods. We appreciate the financial support given by individuals and a number of local combined training organizations and request any individual or group contributions be sent to the USCTA, earmarked for the EEP study. This study's existence and our continued work is possible only through your support. □