Klimaat

Beschutting
Heleski & Murtazashvili, 2010: Shelter usage ranged from a low of <10% of observations in many weather conditions to a high of 62% of observations when it was snowing and wind speed was >4.9 m/s. When wind was >2.2 m/s, there was a significant effect of rain on shelter usage, that is, more horses used shelters in rainy, breezy conditions ($P < 0.01$). When wind was >2.2 m/s, there was a significant effect of snow on shelter usage, that is, more horses used shelters in snowy, breezy conditions ($P < 0.01$). Though overall shelter usage was typically <10%, it appears that shelter access is very important in certain weather conditions.

Holcomb et al., 2013: Housing recommendations for horses invariably include providing access to shade on hot, sunny days but the potential benefits have not been scientifically studied. This experiment measured physiological, behavioral and serological responses of horses confined individually to completely shaded (SH) or completely unshaded (SUN) dry-lot pens during the summer in Davis, CA. Twelve healthy adult horses in a crossover design experienced both treatments for 5 d each. Rectal temperature, respiration rate, skin temperature, and sweat scores were recorded hourly from 1230 to 1730 h daily. Observations were recorded from 1200 to 1800 h for proximity to water, foraging, locomotion, and insect avoidance behaviors. Daily blood samples were obtained to measure cortisol, hematocrit, and neutrophil-to-lymphocyte ratio. Automated and handheld sensors were used to record environmental conditions. The mean ambient temperature from 1200 to 1800 h during the study was 30.6°C. Rectal temperature was greater for horses in SUN than for SH (mean 37.8°C and 37.5°C respectively, SE 0.06, P = 0.002) as was respiration rate (25.5 and 20.5 breaths/min, SE 1.3, P = 0.008), and skin temperature (35.6°C and 34.6°C, SE 0.1, P < 0.001). Horses in SUN showed sweat in 51.4% of observations versus 1.1% for horses in SH. Horses in SUN spent more time than SH horses standing near their water source (34.0% of observations versus 20.2%, SE 0.3, P = 0.004). No differences were observed for foraging, locomotion, or insect avoidance behavior (P > 0.05). Cortisol concentrations were greater in SUN than SH (3.4 and 2.6 ug/dL, respectively, P < 0.001) but remained within the normal range for resting horses. No treatment differences were observed for hematocrit or neutrophil-to-lymphocyte ratio (P > 0.05). Horses exhibited treatment differences in the physiological measures first, most notably in rectal temperature at 1230 h corresponding to peak solar radiation. Behavioral responses followed these physiological changes, with treatment differences in time standing near water becoming apparent at 1400 h as ambient and black globe temperature increased. Our results indicate that both the SH and SUN treatment groups exhibited thermoregulatory responses to these summer conditions and horses benefited from shade, as it mitigated these physiological and behavioral changes. These results are applicable in developing best management practices for the care of domestic horses.

Mills & Clarke, 2002: Horses do not require warm housing and maintaining adequate ventilation is almost certainly more important than maintaining a higher ambient temperature. With acclimatisation, adult horses have been shown to be able to comfortably tolerate temperatures as low as –10 °C (McBride *et al.*, 1983) and even 2-day old foals may tolerate temperatures as low as 5 °C as long as they are well fed –*without a fall in deep body temperature*- (Clarke, 1994). Quartz halogen radiant heaters offer a practical source of extra heat where it is required for foals. Good ventilation should keep the housing environment free of damp and should not generate drafts.

Ammonia is the most common noxious gas to which horses are exposed (-*Clarke, 1987*-). It is released by the action of bacteria on horse's urine and faeces on the floor of the stable. Ammonia damages the mucociliary escalator and increases mucus production. Feeding of high levels of protein can increase ammonia production in a stable but there is considerable individual variation in this context. Ammonia levels increase in poorly ventilated barns especially where drainage is poor and deep litter management is practical. Ammonia levels also generally increase with increasing temperatures and humidities. Methods, which decrease ammonia levels in stables, include:

- Improving drainage;
- Ensuring adequate ventilation;
- Frequent removal of excreta and wet bedding;
- The use of commercially available ammonia control products.

A well ventilated stable will help to decrease the horse's exposure to a wide range of pathogens including; noxious gases, dusts and microbes (Clarke, 1994). Ventilation can also be used to aid in decreasing the risk of moulding of plant-based bedding materials. However, ventilation cannot be used to overcome inherent management problems. For example, a horse can still inhale significant levels of spores from mouldy hays or bedding in a well ventilated stable.

Natural forces of ventilation

The majority of horse stables and barns can be ventilated effectively without the use of mechanical support. There are three natural forces of ventilation:

i) The stack effect. This occurs as a result of warm air rising. The heat generated from horses can be harnessed to capitalise on this effect.

ii) Aspiration. Wind blowing across a roof of a building will suck air out of the building.

iii) Perflation. Air movement associated with wind blowing from end to end or side to side of a building. In exposed locations this natural force of ventilation can lead to drafts and must be compensated for with the strategic location of window, vents and draft dampers.

The ventilation of a building is most tested in still air conditions when the only driving force is warm air rising off the horses. Thus, stables should be designed on the assumption that windless conditions prevail. The relationship between levels of airborne contaminants and ventilation is curvilinear with the concentration of airborne contaminants being directly related to the reciprocal of the ventilation (see Clarke, 1987). Thus the concentration of airborne contaminants increases sharply at low ventilation. Equally, doubling the air change rate at higher levels of ventilation is not associated with a halving of the airborne contaminants. In considering the principles of natural ventilation in still air conditions a target of four air charges per hour with the top door of the loose box or the main doors of a barn closed should ensure adequate ventilation all year round.

Berndt et al., 2010: Stable dust is rich in endotoxin, which may induce neutrophilic airway inflammation. Climatological conditions (ambient temperature and relative humidity) may influence endotoxin concentrations in pastures. The aim of this project was to determine if endotoxin levels in the breathing zone of horses in stables were higher than of horses on pasture, and if the endotoxin on pasture was associated with climatological conditions. Stabled horses are exposed to 8-fold higher concentrations of endotoxin than horses maintained on pastures. Endotoxin concentrations on pasture as well as in the barn are sufficiently high to cause airway inflammation in other species. Therefore, it is likely that endotoxin exposure plays a role in airway inflammation of stabled horses as well, particularly those affected with RAO. Local endotoxin concentrations are more important than ambient climatological conditions in determining endotoxin exposure levels in individual horses. It was concluded that stabled horses are exposed to higher endotoxin concentrations than horses on pastures.

Temperatuur

Morgan, 1998: The thermoneutral zone, defined as the range of temperatures in which an animal maintains body temperature in the short term with little or no additional energy expenditure, was estimated in general for these horses to range from 5-25°C. It was shown that the upper critical temperature is hard to define and varied between 20°C 25°C and 30°C depending on definition.

Cymbaluk & Christison, 1990: Thermoneutrality is undefined for horses (53). Season, region, breed, and age will alter the absolute value of thermoneutrality. Most literature values reported for horses are unsupported by experimental studies. The thermoneutral zone is given at 10°C to 30°C (50°F to 86°F), or 5°C to 27°C (40°F to 80°F) for British horses (11,60), 7°C to 29°C (45°F to 84°F) for American horses (1), and -7°C to 29°C (19°F to 84°F) for Canadian horses (2). These values seem unreasonable for adult horses in temperate climates given that the accepted LCT (lower critical temperature) of newborn calves is 9°C (68). Acclimatization, or adaptation to sustained environmental stressors by metabolic and physiologic changes, modifies thermoneutrality. Adult horses acclimatized to mild Canadian winter temperatures had an estimated thermoneutral zone between -15°C and 10°C (5 F to 50°F) (50). Yet, donkeys acclimatized to summer temperatures in a Nevada desert had a thermoneutral zone of 26°C to 36°C (79°F to 97°F).

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