Air conditioned facilities and cooling stations

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Abstract

Horses are able to acclimatise to heat or heat and humidity as a result of regular exercise in such environments. The majority of the acclimatisation effect appears to be complete after 10-14 consecutive days of exercise[1]. Horses do not need to live in the environmental conditions to which they are being acclimatised and this may actually be counter-productive as horses may not rest adequately or maintain appropriate feed and water intake. In order to ensure horses recover as quickly as possible from transport and daily exercise, air-conditioned stables have been provided in Hong Kong for the 2008 Olympic Equestrian events. Whilst acclimatisation is beneficial, it cannot fully compensate for the climate. Other measures to reduce the risk of heat related illness and to ensure good performance are required. Therefore facilities for cooling horses will be provided. This document outlines how the facilities that will be provided can best be used.

Air-conditioned facilities

Two different types of air-conditioned facilities have been provided for horses at the 2008 Beijing Olympic Equestrian Venue at Sha Tin. These are air-conditioned stables and an air-conditioned indoor training arena (70 x 35 metres) close to the outdoor training arenas and the main competition arena. The aim of providing these facilities is to minimise exposure to heat and humidity under resting (non-exercising) conditions i.e. when stabled and to allow teams an option for reducing or avoiding heat during training and warm-up prior to competition. Riders may also opt to warm-down horses after exercise or competition if this option is permitted by the Technical Delegate.

The indoor air-conditioned training arena also allows teams the opportunity to balance indoor and outdoor training, for example, on very hot and humid days teams may opt to undertake training indoors. Alternatively, teams may opt to split training between indoors and outdoors, with outdoor exercise in heat to achieve acclimatisation and indoor exercise when focus and concentration are required. The indoor arena may also be used when there is heavy rain, although the outdoor training surfaces are well drained and were useable during periods of all but the heaviest rain during the test event.

The surface of the indoor air-conditioned arena is considered to be suitable for jumping but whether this will be allowed is at the discretion of the Technical Delegate. Initial indications at the present time are that jumps of low height only will be permitted.

In order to acclimatise to a hot or hot and humid environment, around 10-14 consecutive days of exercise in the environment is required. Horses that have travelled from a warm or hot environment may need less time to acclimatise,

[1] See: Geor et al., 2000; Lindinger et al., 2000; McCutcheon et al., 1999; Marlin et al., 1996.

whilst horses arriving from a cool environment may need longer to acclimatise. Acclimatisation improves a horse's ability to cope in hot or hot and humid conditions. However, acclimatisation does not fully compensate a horse i.e. the capacity for exercise of an acclimatised horse in a hot-humid environment will always be less than in a cool environment. Typical changes with acclimatisation in horses include a reduced body temperature, a reduction in sweat loss (estimated as weight loss) with exercise and an improved demeanour/ability to cope.

Scientific studies have demonstrated that for horses to acclimatise to hot or hot-humid conditions, raising body temperature by exercise is responsible for the majority of the acclimatisation effect. Living in air-conditioned units and training in the heat is probably equally as effective as living and training in the heat. All human athletes competing at the Beijing Games will live in air-conditioned facilities but will acclimatise with regular sessions of exercise in the heat. For horses, air-conditioned facilities are expected to encourage rapid recovery from transport as thermal comfort is likely to encourage resting, eating, drinking, rehydration and restoration of normal GI and respiratory function.

Measurements of thermal environmental conditions (air temperature, air humidity, radiation and air movement) and air quality (levels of dust and volatile organic compounds) were undertaken in the stables, outdoor arenas and indoor arena during the period of the Good Luck Beijing – Hong Kong SAR 10th Anniversary Cup in 2007.

At the Good Luck Beijing – Hong Kong SAR 10th Anniversary Cup held in August 2007, the condition of the international stables was monitored. All horses under temporary import into Hong Kong for the competition were housed in a single stable. The stable was full and so representative of the conditions that would be experienced during the Games.

The temperature of the stables was set to be around 22-23 °C. During the period of the event the average temperature in the stables was 23.3 °C and ranged from 20.0 °C to 28.7 °C. The rationale for choosing a temperature of 22-23 °C is that 25 °C is considered to be the upper limit of a horse's thermoneutral zone (Morgan, 1998). Above a temperature of 25 °C the horse would need to use additional mechanisms beyond modulation of skin blood flow to maintain normal body temperature i.e. sweating and or increased respiratory rate. How long you have been in Hong Kong, what activity you were undertaking before you entered the stables, the clothing you are wearing and your body condition and your physical fitness will all affect how you perceive environmental conditions. There is also innate variation as to how different individuals sense thermal conditions. In addition, horses being larger than us lose heat more slowly. Thus, what feels slightly cool to a human is likely to feel comfortable for a horse. Care should therefore be taken in requesting changes in stable conditions based on the perceptions of people in the stables.

The target temperature for the indoor arena was 21 °C and during the period of the competition was 21.1 °C (with a range of 18.1 to 25.1 °C). The rationale for choosing a lower temperature than the stables was because horses would be working in the arena. Again, care should be taken not to judge the appropriate temperature for the indoor arena based on the perception of lightly clothed people who have walked in from a hot external environment. This facility is

provided for teams who wish to exercise horses without exposing them to heat, either occasionally or throughout the competition.

Measurements of Volatile Organic Compounds (VOCs) as one indicator of air quality were made in the stables, indoor arena and outdoor arena. The levels of total VOCs in the stables were always higher than in the indoor arena or outside arena. This is almost certainly due to ammonia in the stables as small increases could be seen at the times the bedding was disturbed. However, there was no trend towards increased concentrations with increasing length of residence of the horses, most likely due to the air-conditioning.

The levels of respirable dust in the stables, indoor and outdoor arenas (measured as PM_{10}) according to standard criteria, was always in the range indicating excellent air-quality. There was a change from excellent to good air quality in the indoor and outdoor arenas around the time of competition, almost certainly due to changes in the weather (heavy rain and winds). Poor air quality was only observed on one occasion and this was in the indoor arena when a typhoon was imminent. The most likely explanation for this is that a large amount of equipment was moved into the indoor arena using tractors which would have stirred up the arena surface.

Diurnal variations in respirable dust were also observed in the stables in the morning and afternoon and, as for VOCs, these were most likely due to activities such as mucking out, feeding and sweeping.

However, the air-quality in the indoor and outdoor arenas was extremely good even by human air-quality standards. The air-quality in the stables has to be considered exceptional with no evidence of deterioration due to time of residence of the horses or changes in weather.

Cooling

The horse is a large animal that generates considerable amounts of heat either as a result of short term, intense exercise such as show-jumping or cross-country competition or as a result of more prolonged exercise at medium intensity such as dressage. The extent to which a horse is blowing (taking deep breaths at a rate of around 60-80 breaths/min) is a good indicator of how hot a horse is. Horses blow primarily due to increased body temperature. A horse that is hot attempts to cool itself by a combination of sweating and panting (increased rate and or depth of breathing). In a hot horse, around 85% of the heat is normally removed by sweating versus around 15% by panting. As the air temperature increases, the efficiency of sweat evaporation and natural cooling increases, but as humidity in the air increases, the efficiency of sweat evaporation decreases. At 100% relative humidity no sweat can evaporate.

In Hong Kong the humidity is usually moderate to high in August. This means that if left to cool themselves by sweating horses will cool slowly and also experience significant fluid and electrolyte loss leading to dehydration in the short-term and possibly to problems associated with excessive electrolyte loss (e.g. tying-up or synchronous diaphragmatic flutter) in the medium to longer term.

Heat related illness in horses can occur either as a result of a very high body temperature being reached or due to exposure to a moderate to high body

temperature for a longer period of time. As in people, individual horses will have different susceptibilities to heat. The most important approach to reducing the risk of heat related illness in horses is to use a programme of acclimatisation and to use assisted cooling. In Hong Kong there will be two types of cooling facility available: cold water stations and misting fan stations. Cold water stations will consist of large volumes of chilled water (5-10 °C) made available in tanks with buckets or sprays. Misting fan stations will consist of a covered area with open sides. Down each long side will be a line of fans with nozzles fed from a reservoir of cooled water (~15 °C) spraying a mist into the covered area.

Cooling stations

Previous studies have shown that application of cold water to horses that are hot after exercise does not cause rapid decreases in muscle temperature, that there is no significant vasoconstriction of blood vessels in the skin that inhibits cooling and is the most effective way to reduce body (rectal temperature) (Kohn et al., 1999; Marlin et al., 1998; Williamson et al., 1995). Furthermore, cooling with cold water after exercise does not cause muscle damage (Williamson et al., 1995). The efficiency of this type of cooling depends on three factors: (1) the temperature difference between the horse's surface and the water applied; (2) the area of body surface that is covered by the water; (3) the volume of water applied. There will be four spray stations at the main venue, two in the main venue and two at Penfold Park. Spray cooling stations will also be provided at the cross-country venue at Beas River.

Suggested procedure for optimal cold-water assisted cooling

The horse and rider should be encouraged to continue exercising, even if only at walk or trot until they reach a cold-water station. During exercise, the blood flow is primarily directed towards the muscles, even at the expense of thermoregulation. When exercise stops, there is marked vasodilation (opening) of blood vessels in the skin. At the same time, the lack of regular muscle activity reduces venous return to the heart. This combination of factors can lead to hypotension and horses may be observed to become ataxic and even recumbent as a result. It is therefore important to try to avoid bringing horses to a complete halt immediately following exercise for more than a short period during which cooling should be instigated.

If possible, cooling should be undertaken in the shade but this is not essential. The horse should be covered from head to tail in cold water, on both sides of the body and over all areas continuously for approximately 30 seconds after which the horse should walk in a circle for approximately 15 seconds. The short periods of walking help to promote circulation and maintain skin blood flow. If possible and if tolerated by the horse, application of cold-water can be continued whilst the horse is moving.

Water can be applied using buckets or sprays. Sprays (Fig. 1) are easier to control and cover the whole horse, especially with two people – one working on each side of the horse. There is no requirement to scrape water from the horse at any time in the cooling procedure. Only a thin layer of warm water will ever build up on the surface of the horse and this will be displaced or cooled by application of more cold water.

In order to cool a horse 1 °C (i.e. to reduce its body temperature by this amount) may take 10 minutes of intensive cooling. Horses finishing the cross-

country may have rectal temperatures close to 42 °C or higher and thus it may take 20-30 minutes of cooling to make them comfortable and to significantly reduce or eliminate blowing.

Taking rectal temperature in horses after intense exercise can be misleading as this tends to lag behind core or muscle temperatures. It is not uncommon for rectal temperature to increase in the first 5-10 minutes after intense exercise. Thus, in a horse that finishes cross-country with a rectal temperature of 41 °C and is still showing a rectal temperature of 41 °C after 5 minutes of intense cooling, this should be taken as a sign that the cooling has been effective rather than ineffective. If the cooling had been ineffective the rectal temperature would have risen.

Common mistakes in cooling horses in this way are:

1. Underestimating the volume of water that needs to be applied
2. Concentrating on or avoiding specific areas of the body rather than utilising the whole of the horses' surface (Fig. 2)
3. Not allowing short periods of walking during the cooling

Rapid and efficient cold-water cooling is essential for horse welfare immediately following exercise in horses that are hot. It may also be indicated in horses following warm-up but prior to competition. Warm-up has physical and psychological components. Whilst a small increase in muscle temperature improves muscle strength, prolonged or intense warm-up, especially in hot or hot and humid environments may have a negative effect. Studies in human athletes have indicated that pre-cooling is beneficial and may even enhance performance. Cooling horses before competition will not necessarily reduce the amount of heat that is produced during competition but will reduce the absolute temperature horses reach during exercise.

Misting Stations

Misting stations (Fig. 3) are provided as an addition to cooling stations and should not be considered an alternative. Cooling stations are an effective way to reduce body temperature rapidly. Misting stations are provided for short-term comfort and are significantly less effective at reducing body temperature in hot horses. In dry environments the efficacy of misting fans is related to the speed of the fans, the amount of mist and the air temperature. In hot dry environmental conditions the cooling effect is by evaporation of the mist. In hot humid conditions any cooling effect is primarily related to the temperature of the water supplied to the fans as evaporation will be low. In Hong Kong the aim will be to supply water to the fans at a temperature of ~15 °C. This will provide a local comfortable microclimate. People standing in the misting stations will perceive the cooling effect to be greater than it will be for horses. This is due to smaller body size and exposed areas of skin.

Misting stations should be seen as a facility to be used in conjunction with cooling stations, but never instead of them. Horses can be stood in misting stations or walked through or around inside them after they have been cooled or during rest periods in training or prior to competition.

To reiterate, misting stations provide a microenvironment that is likely to be cooler than outside but are for comfort not for effective cooling.

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Fig. 1. A horse being cooled with a combination of cold-water sprays and cold-water from buckets in shade following completion of the cross-country at the Good Luck Beijing – Hong Kong SAR 10th Anniversary Cup in 2007.

Fig. 2. A horse that has been cooled to a greater extent over the hindquarters and to a lesser extent over the chest and neck. The hindquarters are around 19 °C whilst the chest, head and neck are around 30 °C, indicating that this horse is still hot and requires further cooling.

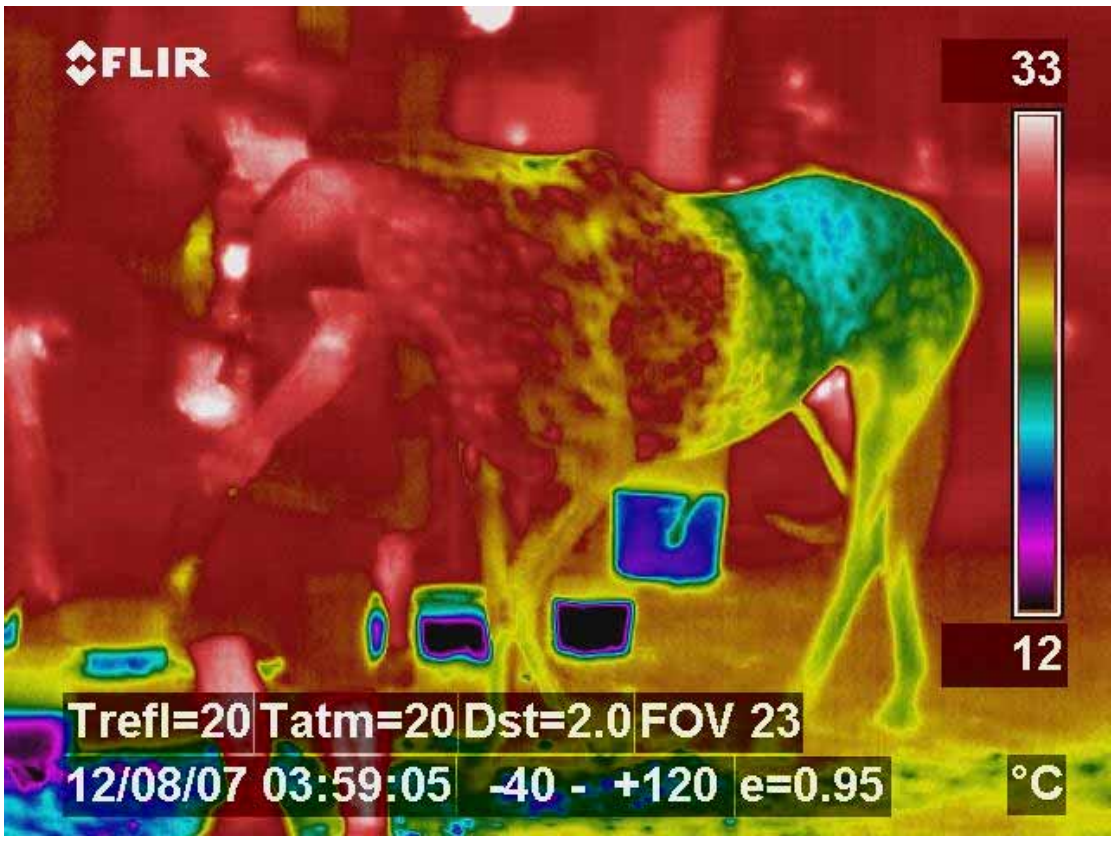

Fig. 3. Misting station at Beas River.