
HOW DO HORSES THERMOREGULATE (MAINTAIN BODY TEMPERATURE) WHEN IT IS COLD?

Horses are mammals and as such are warm-blooded just like humans and so when the air around them is colder than their body temperature, heat transfers from them to the environment and they get colder. To survive they must regulate this heat loss, however such heat loss is not always detrimental, for example if the horse is too hot and needs to cool down. This is why horses are in danger of overheating when worked in hot conditions. Their body temperature rises due to energy released from exercise (or when it is very hot, heat absorbed from their environment) and they need to move that heat to their surrounding environment. They cannot do that though if the surrounding environment is as warm or warmer than they are. So the environmental temperature and body temperature determine the extent to which heat must be conserved. If the horse remains in its comfort zone or "thermo neutral zone" little needs to be done to regulate temperature. Once at the bottom of this comfort zone the horse reaches its critical temperature and the body speeds up chemical reactions within the body in order to burn more calories and to create more body heat. This requires an increase in dietary energy intake, if there are not enough calories in the diet to meet the additional needs for maintaining body temperature the horse will utilize its body energy reserves (fat). This deficit continues for too long body condition will be compromised and the horse will lose weight. (See September 2007 newsletter, Getting Ready for Winter for an explanation of energy balance and body condition score). Exercise produces heat from energy burned by muscles so moving is another way the horse has to stay warm but the energy for movement has to come from somewhere, either the diet or body energy reserves. This is one reason why horses seem to run around more when the weather is cold. Muscle contractions don't just occur though as a result of the horse physically changing locations they also occur as a result of shivering. The energy produced from these muscle activities raises the horse's core temperature. Other sources of heat that don't require feed or body energy reserves are the sun and such things as heat lamps.

There are of course also ways of conserving energy and heat in order to stay warm. Just like us, horses can reduce the blood flow to their extremities such as their ears, muzzle and legs. This is why it is often said that to tell if a horse is cold one should touch its ears. If you think you might use this as a barometer I suggest feeling them when the horse is not cold so you can tell the difference. Trying to figure out from the ears whether a horse is cold when the whole horse is wet from standing in the rain for several hours is not as easy as it sounds, everything just feels damp and often you wonder whether you can't feel any heat because you are cold as well! Also like us horses can make their hair stand-up which is called piloerection (think of goose bumps) which acts to increase their hair depth and traps air next to their bodies creating an insulating layer. It is because of this function that you might hear people say that well cared for horses are quite alright out in the cold as long as it is dry. Once their coats get wet the hair is unable to stand up and create this insulating layer. They then rely on the oils in their coat to prevent their skin from getting wet, which is why you should not bathe a horse that lives out in the winter or use a body brush, they need the oils to stay near their skin to act as a protective barrier. Horses living outside need to have access to adequate shelter such as a 3 sided shed as such shelter has been shown to reduce heat loss by 20% not only because it allows their hair to stay dry but it also reduces heat loss from wind chill. Before we get to wind chill I want to mention that piloerection is also why some people do not believe in using blankets and actually think blankets can cause a horse to be colder. This is certainly true if the blankets do not contain adequate insulation for weather conditions. A blanket flattens the horse's hair and

prevents piloerection. If in turn the blanket is not thick enough to adequately insulate or it leaks, the horse it will be cold and will not be able to use piloerection to stay warm. This is not to say that blankets should not be used, if you have a horse who does not carry much weight, with a thin hair coat or decide to clip your horse because it is in heavy work, a blanket will be necessary. A quick word of caution against thinking that by bringing your horse into a stable (box stall) during cold dry weather that it will be warmer, this may be true but also consider that in a stable there is limited space for movement, there are no other horses to huddle up with, air is often still and cold, and there is less heat from sunlight available. In my experience during such dry cold conditions, stables (box stalls) are often colder than outside. Often the coldest part of the night is around 6am, as the sun comes up areas reached by sunlight warm up quickly compared to those areas still in shade such as the inside of stall, so horses in stalls are subjected to cold for far longer than those horses that can get out into the sun. This can cause a real conundrum in spring and autumn when your stabled horses are blanketed at night and you need to take their blankets off early in the morning before you go to work because later in the day they will be hot. In these instances you have to know your horse and know whether it is better for them as an individual to be too hot or too cold. The hard keeper who is lean, gets cold and is stressed easily would probably be better left with the blanket on versus the horse carrying more condition who won't be at any great detriment if he is a little chilly for a couple of hours.

The critical temperature mentioned earlier can be used to determine what your horses nutritional requirements are relative to ambient temperature, wind chill and wet hair coat. According to an article by the University of Maine Cooperative Extension, "estimates for the lower critical temperature (LCT) for horses are between 30 and 50 degrees Fahrenheit depending on hair coat, body condition, wetness and windchill". They go on to give the lower critical temperatures in degrees Fahrenheit based on hair coat as follows, wet or short hair 60, moderate length hair coat 50, heavy coat 30. Once the average temperature reaches the LCT human intervention is required such as shelter, a blanket and or extra feed. In the last newsletter (September 2007) in the "10 things to do now to prepare for winter" I suggested making a plan on how you will keep track of the weather over the winter in order to make good management decisions. This is because you not only need to know if there is going to be a significant drop in ambient temperature but also what the temperature will be with wind chill, as movement of air across skin causes increased heat loss. Sometimes you will see on weather forecasts a temperature and then a "feels like" temperature. This is the temperature accounting for wind chill. The National Weather Service has a wind chill chart that shows for any given ambient temperature and wind speed combination what the wind chill temperature will be. For example when ambient temperature is 35 degrees Fahrenheit and wind speed is 10mph wind chill temperature is 27 degrees Fahrenheit, and when ambient temperature is 35 degrees Fahrenheit and wind speed is 25mph wind chill temperature is 23 degrees Fahrenheit. Water freezes at 32 degrees Fahrenheit so without accounting for wind chill these examples are above freezing, but with wind chill both drop the temperature below freezing.

So how do you adapt your feeding regime to insure that your horse has enough energy when the temperature drops? It is estimated that for every 5 degree drop in temperature below the horses LCT an additional 1 Mcal/day are necessary which roughly equates to an additional 1 lbs of grass hay. It is not only safest to make relatively quick changes in diet through alterations in hay in order to avoid colic and laminitis, but when we want to raise internal heat production, increased hay consumption is best. Hay is digested by bacteria/microbes in the horse's cecum and large intestine and this microbial fermentation actually produces heat which warms the

horse from the inside. If we think back to our 1100 lb horse from last month (who we'll call Bobby) he needed 16.7 Mcal/day for maintenance and if we say that he has a medium hair coat and therefore a LCT of 50 degrees Fahrenheit, then when the temperature drops to 40 degrees Fahrenheit, Bobby will need 18.7 Mcal/day. Assuming 1 Mcal/lb of grass hay this is a change from 16.7 lbs to 18.7lbs. Most horses will happily eat 2-2.5% of their body weight per day in dry matter if fed free choice which for Bobby would be 22-27.5 lbs per day of hay. So a horse at maintenance should easily be able to consume all the energy needed to stay warm and maintain body condition from hay alone. However, if a horse is working and needs energy not only for maintenance and warmth but also work, then the energy requirement will be greater and it may not be possible to meet this need from hay alone although as much of the need as possible should be met from hay for the reasons previously mentioned. If you follow the weather forecast and know a storm is coming and what the expected temperature will be it is relatively straight forward to make the necessary changes in hay intake necessary. Ideally these changes should be made in the 24 hours leading up to the expected lower temperature and maintained throughout the cold spell.

Horses do adapt to cold over time, according to Dr Cymbaluk of the ministry of Agriculture, Food and Rural Affairs in Ontario Canada, horses typically require a 10-21 day adaptation period. A horse's ability to adapt depends on the duration of the cold weather and the horse's energy intake. A horse isn't going to be able to adapt to a sudden winter storm and will require more intervention. However, energy intake is more critical. Well fed horses adapt better than those who are underfed. Adaptation should be considered when contemplating a horse's lower critical temperature. A horse who has spent a good amount of time in Arizona where the average summer high is around 95 degrees Fahrenheit and average winter low is around 55 degrees Fahrenheit may hit its lower critical temperature at a relatively higher temperature than a horse who lives in Maine where the average summer high is only around 70 degrees Fahrenheit but the average winter low is around 20 degrees Fahrenheit. For the horse from Arizona the lower critical temperature may be 60 degrees even with thick haircoat. The age of the horse is also worth considering. Older horses are generally less efficient at both digestion and thermoregulation and so are more susceptible to extremes in temperature. They will therefore need a diet that is more easily digestible and may require intervention earlier than their younger counterparts to stay warm. Young horses especially those under a year of age are also less able to handle cold weather in part due to the large amounts of energy that are being utilized for growth. They should be provided with good shelter and ample access to good quality hay.

Your horse will tell you if he/she is cold, pay attention to the warning signs and make adjustments to hay intake and overall management as necessary to insure that your horse comes out of the winter in good condition. ☺
