

Nutrient Replacement for Optimum Performance

Feeding a balanced diet then taking care of nutrient replacement after exercise is imperative to keep horses performing well at an upper level of performance. Don Kapper, shared his wealth of knowledge in equine nutrition and management in a recent visit to Canada. His talk at the University of Guelph discussed the importance of understanding gut function and nutrient absorption in order to understand the importance of nutrient replacement. Assessing body condition and topline evaluation scores were addressed as was the importance of providing good quality protein as a source of amino acids to avoid deficiencies that can negatively affect topline muscles, tendons, hooves and overall health. Last but not least, the role of electrolytes were discussed to avoid dehydration and keep athletes bouncing back into top form for the next day of competition.

GUT FUNCTION

“Horses are designed to be continuous grazers,” explains Kapper. An 1100 pound horse will eat up to 18 hours a day consuming 2.0% to 2.5 % of their body weight per day in dry forage (22 to 28 lbs). While doing this, they will produce between 25 to 30 gallons of saliva, significantly reducing the chances of acid gut syndrome and improving nutrient absorption and over-all gut health. Horses only produce saliva when they chew, therefore, feeding forage ad-lib will increase the production of saliva – one of the best buffers for the horses’ digestive system and the most effective way to reduce the chance of ulcers and impaction colic. Kapper brought home another benefit of continuous grazing by comparing the small intestine to sausage casing, “When it is full it is almost impossible to twist.” Going without eating for several hours at a time can be a factor in colic resulting from a twisted intestine.

The stomach of the horse is relatively small and food only stays there for around 15 minutes, where acids begin to break it down. Moving through the next 90 foot of small intestine, it takes between 30 – 90 minutes, therefore, it moves at a rate of one to three feet per minute. Now you can understand why horses seem to be hungry all the time. The small intestine is the primary absorption sight of amino acids, fatty acids, major and trace minerals and vitamins. Therefore, the quality of the forage and feeds fed to a horse is more important than the quality of the forage and feeds fed to ruminants (cattle, goats and sheep, etc.). Ruminants will break down the crude proteins and form needed amino acids in their rumen, then it travels into the small intestine for absorption to occur. In horses, all food goes into their stomach, then small intestine, and then into their fermentation vat (cecum) to be broken down. Unfortunately, their fermentation vat is AFTER it passes through the small intestine, the primary absorption sight for many nutrients. That is why ruminants will get more nutrients out of the same forage than a horse. The quality of ingredients, or the availability of the nutrients fed to horses, are far more important than the quality fed to all ruminants.

The hind gut of the horse makes up 62% of their digestive system, which functions with a microbial population breaking down the fibre in forages by fermentation. Forage should make up 50% to 90% of a mature horses total diet. Therefore, knowledge of the nutrients in your forage is important so you can factor in what your horse may need in the way of concentrates and/or supplements to meet their needs every day. Kapper says, “If you don’t know what nutrients are in your forage, you are guessing at what needs to be added. If you don’t know what nutrients your horse needs every day – you are guessing at everything.” He stressed, be an educated consumer, because economics come into play when you feed

more than you need, but even more so, if your horse breaks down or becomes ill due to deficiencies in their diet. Kapper also reminded us that concentrates are never to exceed 50%, by weight, of the mature horse's total diet/day or exceed five pounds in one feeding/1,000 lbs of body weight. This is to avoid digestive upsets. Emphasis was put on good forage to meet the nutritional needs, optimize digestive health and improve the overall well-being of your horse. Ad-lib forage will also facilitate the best mental state.

VISUAL ASSESSMENT

Performance loss will occur before you see visual changes in your horse that may indicate an unbalanced diet. Visual changes that put up red flags include: loss of muscle over the topline, then a decline in hoof and hair quality and finally a loss of appetite and general unthrifty condition.

Checking the horses **Body Condition Score** on a monthly basis provides a good visual indicator for achieving optimal calorie intake with the ideal being between five and six on a scale of one to nine (Body Condition Scoring link <http://www.equineguelph.ca/news/index.php?content=408>). However, it is possible to have a horse in ideal body weight and still be deficient in nutrients required to build and support the muscles necessary to perform athletic tasks. Muscle soreness and changes in saddle fit are early indicators of a diminishing topline.

Topline Evaluation Scoring (TES) is graded from A to D, looking at the muscles on the horses back, loin and croup areas. Loss of muscle (muscle atrophy) is a solid indicator of an amino acid deficiency. Amino Acids are the building blocks that make up crude protein. Muscles contain 73% protein and the first limiting amino acid will determine how much 'all' of the other amino acids in their diet can be utilized. The easiest and first place to visualize a horse losing muscle mass, when a deficient amino acid diet is fed, is in their back area; the second is their loin; and third is their croup area.

TOPLINE GRADES with DEFINITIONS:

Grade A- The horse has 'ideal muscle development'. The back, loin and croup are full and well rounded. The topline muscles are well developed and blend smoothly into his ribs. The horse should be able to perform work requiring the use of all of these muscles.

Grade B- The 'back area is concave' (sunken) between the vertebrae and the top of the ribs:

1. You may have trouble fitting this horse with a saddle.
2. The muscle atrophy in this area may cause back soreness when worked.
3. Soreness can negatively impact their attitude and performance.
4. The loin muscles are well developed and are the same height as the spinal processes, i.e. you cannot see or palpate the spinal processes.

Grade C- The 'back and loin areas are both concave' (sunken) between the vertebrae and the ribs:

1. The 'spinal processes' in the loin area are higher than the muscles beside them and can easily be seen and palpated.
2. The atrophied muscles in the back and loin areas weaken the horse.
3. The length of time they are able to work and perform will be compromised, causing them to tire easily.
4. Muscling over the croup and hindquarters are well developed and rounded.

Grade D- All three areas of the topline, including the back, loin and croup areas are concave (sunken):

1. The croup appears pointed at the top since the vertebrae and hip bones are higher than the muscles in-between them.
2. In severely affected horses, the width of their stifle is narrower than the width of their point of hip.
3. This horse will lack the strength and stamina to perform and the muscle atrophy will cause discomfort when worked.

ROLE OF PROTEIN/AMINO ACIDS

All 10 essential amino acids need to be provided to horses on a daily basis: arginine, histidine, isoleucine, leucine, lysine (involved in growth and development), methionine (for hoof and hair quality), phenylalanine, threonine (involved in tissue repair), tryptophan, and valine. There are also 12 non-essential amino acids that horses can create themselves in adequate amounts. In order for crude protein to be synthesized, all the 'essential' amino acids must be present in adequate amounts. If one amino acid runs out, it 'limits' protein synthesis for the rest of the amino acids.

If you are feeding a grass hay, your first limiting amino acid is going to be Lysine. For alfalfa, the first limiting amino acid could be threonine or tryptophan. Knowing what 'type of forage' you are feeding is key to knowing what supplements you need to choose to complement your horse's diet.

During the process of conditioning horses, muscles are torn down during exercise and need additional branch-chain amino acids (leucine, isoleucine and valine) replenished to repair and rebuild those muscles faster. Kapper draws the parallel of weight trainers reaching for their whey protein shake after a work-out. A horse can benefit greatly from having 4 – 10 ounces of branch-chain amino acids replaced within 45 minutes of a workout. Whey is the best quality protein (amino acid) source, followed by soybean. Research has also shown that a lack of amino acids in the diet can affect the utilization of minerals in the diet, potentially causing skeletal and soft tissue problems.

To get an idea of their importance - take a look at the amino acid content in the following structures:

Hair and hoof	= 95%
Muscle	= 73%
Tendon	= 93%
Bone	= 30%
Skin	= 90%

A shortage of 'one' essential amino acid will affect the quality and strength of all of the above. The first one you will 'see' is the one with the fastest turn-over.

What the Hooves Can Tell You about the Diet

THE ORDER OF NUTRIENTS FOUND INSIDE THE HORSES HOOF:

1. Protein/Amino Acids = 95 %
2. Fat/Oils = 3 %
3. Sulfur
4. Calcium
5. Zinc
6. Copper

7. Selenium
8. Carotene (Vitamin A)
9. Alpha-Tocopherol (Vitamin E)
10. Biotin (Recommend 15 mg/day/1,000 lb of body weight, for “sand” cracks in hooves)

When 98% of the hoof is made up of the top two nutrients, begin working with those and work your way down the list for a systematic way to address hoof quality problems that may be nutrition related. Too many times we hear about individuals beginning with Number 10 and work their way up the list. Here are a few examples to help you begin ‘problem solving’: Slow growth can result from inadequate amino acids, while poor expansion and contraction, with cracking of the hoof wall, can result from inadequate oils in the hoof. A poor quality lamina (white line) can result from a low ‘sulfur’ containing amino acid diet, i.e. Methionine & Cysteine. In a calcium deficient diet the middle of the hoof wall can break down and crumble. Sand cracks in the outer service of the hoof wall can be an indicator of a lack of biotin.

CALORIE SOURCES TO FUEL MUSCLE FUNCTION

Choosing the right horse for the work you want to do is important right off the bat (genetics). Then you need to choose the right fuel for your horse’s muscles to perform up to their genetic potential.

Carbohydrates and Fats and Oils

Soluble carbohydrates are the starches and sugars needed to provide the ‘glycogen’ for intense work. Kapper uses a quarter horse sprinter fueling its bulky ‘fast twitch’ muscles as an example. Glycogen produced from these carbohydrates are utilized when their heart rate exceeds 170 beats/minute, in **anaerobic work**. “The heart rate is the key to knowing what kind of fuel you should be using,” says Kapper. Soluble carbohydrates are highest in cereal grain: oats, corn, barley, wheat...

Fats and Oils - Kapper says the Arabian is a good example of a breed using long, lean ‘slow twitch’ muscles that burn fat rather than glycogen for fuel. Soybean, flax and fish oils are high in Omega 3’s which have anti-inflammatory responses, as opposed to corn oil and sunflower oil which are high in Omega 6’s which have pro-inflammatory responses. Vegetable oils can provide slow, long term energy needed for low to moderate intensity, **aerobic work**. Oils containing higher levels of Omega 3’s are recommended for this kind of work.

Kapper then went on to explain that a portion of the muscles of the Thoroughbred and Warmblood can be trained to be ‘fast or slow-twitch’, depending on what ‘fuel’ you are feeding.

Forage Digestibility

Of course, it is important that your horse is able to get the most out of the bulk of its diet. Soft hay is more desirable for the performance horse because its nutrients will be higher and is easier to digest. Over mature hay is cut later, will have grown taller and have larger, courser stems. This hay will be higher in lignin, which makes it less palatable and lower in digestibility, i.e. quality.

ROLE OF ELECTROLYTES

Given correctly, the use of performance electrolytes can delay the onset of fatigue by over 22%. They can also reduce muscle cramping and improve the horse’s ability to bounce back and perform at the

same high level the next day. The amount of sweat produced in a workout will determine the amount of electrolytes which require replacing. The demands are highest during hot and humid weather. The heat stress index chart is an important calculation when determining the risk of dehydration. (link: <http://www.equineguelph.ca/news/index.php?content=419>)

When correctly formulated, electrolytes will replace the ions lost in sweat. For performance purposes – the electrolyte should specify it is a “performance” electrolyte on the label. The ingredient dextrose should be present because it is essential to improve the absorption rate of all the ions. The amounts of sodium, potassium and chloride levels are usually provided in the labels ingredient list. Adding the amount of sodium and potassium together should come close to equaling the amount of chloride in the formula. When you compare the amount of these three ions, you will see that not all electrolytes on the market today are created equal! The higher quality electrolytes are palatable, while lower quality ones are bitter, salty and discourage consumption when top-dressed on feed or mixed in water.

Before electrolytes can be absorbed they need to be broken down with water. Delivery of a powdered electrolyte in feed or water is acceptable as long as they can continue to drink water. If water is not available or the horse does not drink after administering dry electrolytes, the horse will take water from its body and put it into their digestive system to break the powder down. Mixing electrolytes in water will reduce the absorption time in the small intestine. All electrolytes are hygroscopic, which means if fed in powdered form and the horse does not drink water, they will dehydrate the horse. Paste electrolytes are to be avoided due to their ‘short term affects’. They will lay in the gut and actually pull water from the horse’s body, increasing dehydration, at the most critical time after exercise! This was proven and published by Equine Guelph’s research team, led by Dr. Mike Lindinger and Gayle Ecker, a few years ago.

Depending on how hard the horses are working, a ‘performance electrolyte solution’ can be made by mixing one ounce of powder per litre of water. Increase the number of litre’s of this ‘electrolyte solution’ as the horses training intensifies and/or the ‘Heat Stress Index’ (HSI) increases. HSI is determined by adding the temperature (F or C) and the percent Humidity, together. **‘Mild’ HSI** begins when the combination is <140 when using Humidity plus Temperature (F); or <90 when using Humidity plus Temperature (C); **‘Moderate’ HSI** is between 140 – 160 (F) or 90 – 105 (C); **‘Severe’ HSI** >160 (F) or >105 (C). (See chart provided on the link: <http://www.equineguelph.ca/news/index.php?content=419>) This ‘electrolyte solution’ should be given with-in 45 minutes after the horse’s workout. When the humidity and temperature increase, causing the ‘heat stress index’ to climb to ‘Moderate’ to ‘Severe’, the number of litre’s offered should increase according to their training level. One ounce/litre of water will provide the correct osmolarity for the fastest absorption and utilization by the horse. For example: for **‘Moderate’ Heat Stress Index**: provide two litres for training level, four litres for moderate and six litres for intense training. In the cases of ‘moderate’ to ‘intense’ training levels, providing the ‘electrolyte solution’ will work much better than top dressing it on feed.

More factors effecting dehydration can include: the trailer ride to the venue if it is a hot day, a decrease in water and food intake from the stresses of being in a new location or from the water tasting different. Add the workload of the day on top of that and you can have a severely dehydrated horse on your hands.

Checking for dehydration can include the skin pinch test where the handler pinches the skin on the horses shoulder then checks that it flattens back down in one to one and a half seconds. The capillary

refill test is another method, pressing on the horse's gums and seeing the colour return to pink in under one and a half seconds.

(link: http://www.equineguelph.ca/pdf/infosheets/Dehydration_Infosheet_July_2014.pdf)

SUMMARY

Kapper encourages horse owners to be pro-active in their feeding programs. Know the 'ideal' body weight of your horse and what nutrients are in your forage. These nutrients will vary with the 'type' of forage (grass vs. legume) and its level of maturity (when it was cut). Knowledge of this will allow you to make informed decisions when choosing feed and/or balancers to make up the difference between what your horse is getting from its forage and what it needs. Be sure to read the 'purpose statement' on every feed tag and feed according to their 'Feeding Directions' in order to fulfill nutrient requirements. Always choose a feed that is tailored to the individual needs of the horse (size, breed, age, workload...) and feed according to the instructions. Kapper cautions, "Feeding less than recommended amounts/day, means you have chosen the wrong feed and it could result in nutritional deficiencies". Stay observant if performance declines and be quick to pick up on the visual clues that the diet may need balancing, i.e. loss of muscle over the topline, decline in hoof and hair quality, loss of appetite and loss of condition could all be indicators of amino acid deficiency and/or an unbalanced diet. For horses in moderate to intense training, giving amino acids and electrolytes with-in 45 minutes after workouts can replenish body reserves the fastest. **Nutrition is the science of prevention.** Understanding the role of nutrition and working with an equine nutritionist will put you on the road to optimal health and performance for your horse.

Bio:



Don Kapper is a highly experienced equine nutritionist and a member of the Cargill Equine Enterprise Team. Don graduated from Ohio State University and achieved his credentials as a Professional Animal Scientist from the American Registry of Professional Animal Scientists in 1996 and has been a sought-after speaker for equine meetings in both the U.S. and Canada. He was a member of the "Performance Electrolyte Research" team at the University of Guelph and wrote the chapter on "Applied Nutrition" for the authoritative veterinary textbook: "Equine Internal Medicine", 2nd edition. Don also co-developed the "Equine Nutrition" course for the Equine Science Certificate program for Equine Guelph and has been a popular guest speaker in several Equine Guelph online courses, including the Equine Growth and Development, Exercise Physiology and Advanced Equine Nutrition.