

Endurance in Equine Sports

Endurance is an important metabolic requirement of horses involved in many sports, from endurance racing to eventing and harness racing and even for galloping "stayers".

Energy Demands in Endurance Events

All exercise utilizes both aerobic & anaerobic energy pathways to regenerate the ATP "fuel" essential for continued muscle contraction. The relative contribution of both pathways depends on the intensity and duration of the exercise. Training and conditioning the metabolism of an endurance horse is aimed at:

- improving maximum oxygen uptake,
- increasing the ability of muscle to provide energy,
- increasing the efficiency of utilisation of various energy substrates (carbohydrate, fats, proteins),
- improving the ability of the horse to manage temperature and handle waste product accumulation created by long, hard exercise

Aerobic (with oxygen) energy production provides about 90% of the energy required by endurance horses.

Genetics Plays a Role in Endurance

Genetics influences the metabolic systems a horse can use, as successful endurance or "staying" horses possess higher numbers of "Slow Twitch" muscle fibres than, e.g., successful sprint racehorses. Slow Twitch fibres use mainly aerobic energy pathways, are more resistant to fatigue, have greater ability to convert energy, and have a very rich blood supply. They allow a horse to cover long, hard endurance rides with efficiency, but don't necessarily produce the power and speed seen with "Fast Twitch" fibres predominant in successful sprint racehorses.

How Muscles Avoid Fatigue

Muscles rely on the cell fuel ATP for energy during muscle contractions. The cells can carry only a very limited supply of ATP, and it must be constantly regenerated during exercise to keep the cells functioning. Metabolising foods in the presence of oxygen (aerobic energy production) is a very efficient way to produce ATP, and able to be carried out for long periods. Efficient aerobic energy production is essential to the endurance horse, and is the energy pathway endurance riders aim to use as much as possible.

Long, slow distance training improves the capacity for aerobic energy production.

During short, intense exertion (hills, sprints, jumps), energy generation will be mainly anaerobic, because oxygen is not able to fuel the intense muscle activity sufficiently. This pathway produces large amounts of lactic acid & other metabolic wastes.

Fatigue is impairment of muscle fibre function due to lack of viable energy supply. **The ability to maintain performance is limited by the onset of fatigue.**

Lactic Acid - a sign of muscle fatigue

As exercise continues, increased use of anaerobic energy pathways builds levels of lactic acid and other toxic waste products. **The more strenuously a horse works, the more rapidly muscles become acidotic.** The presence of high concentrations of lactic acid is a signal that muscle cell fatigue is present or imminent.

Effective training delays high reliance on anaerobic metabolism (except in horses that move immediately into intense anaerobic effort such as sprinters and jumpers) so delays the onset of fatigue and concurrent lactic acidosis. The clinical signs of muscle fatigue and Tying Up (reduced muscle function, cramping, pain) are caused by the inflammatory effects of lactic acid and other metabolic waste products when they occur at high concentrations in muscle. These waste products also elevate heart rates & delay recovery. Cessation of muscle contraction is also partly due to the muscle cells simply running out of ATP energy as the aerobic and anaerobic replacement systems become overwhelmed. As exercise continues, the blood becomes acidic as the waste materials produced by muscle work accumulate.

The first priority in endurance management is to reduce the accumulation of waste products in working muscle, by delaying cellular fatigue.

Buffering - the body's way of reducing acidosis

Muscles have a natural "buffering" system to prevent the tissue from becoming overly acid. Over 95% of the buffering of muscle is carried out by two substances: Carnosine and Phosphate. Bicarbonate "bicarb" is an additional acid buffering compound available in the blood.

Phosphate - vital to performance

Throughout work, muscles use large amounts of phosphate during ATP regeneration. Loss of phosphate reduces the ability of muscles to buffer lactic acid (phosphate is alkaline, to counter the acidity of lactic acid), and also reduces the muscle's ability to regenerate APT fuel. This reduces performance and is associated with early onset of metabolic muscle fatigue.

Phosphate is also used for the conversion of glycogen into ATP to fuel muscle activity, and improves the delivery of oxygen into muscles by allowing oxygen to leave the blood haemoglobin molecules and enter the muscle tissue. Phosphates are important dietary components for the maintenance of metabolic energy needs.

COPHOS B PASTE



High energy phosphate supplement.
30 mL & 250 mL paste or 100 mL sterile injection

"Load" muscles with phosphate by giving Cophos B for 3 - 4 days prior to hard events to improve both aerobic and anaerobic work efficiency and performance. Alternatively, use 2 - 3 times weekly (before hardest training days) and top up 4 - 6 hours pre-event. Use during training means the muscles are in better condition for the event! Use after event as well to improve recovery.

GREEN AMINO POWDER



Excellent pre-ride energy & post-event recovery drench.
300 g foil sachets

High in L-Carnosine, the major muscle buffer, which combines with phosphates to perform 90% of muscle buffering.

Also contains L-Carnitine to facilitate the use of fats as a

primary energy source, essential B vitamins, glycine, glucose, electrolytes sodium, potassium & magnesium, calcium, triglycerides and antioxidants. An extremely useful supplement to maximise energy supply to muscles during long, hard work periods. Also given after events to improve muscle recovery and repair.

Mix contents in 2 - 3 litres warm water and give as drench before hard work. Alternatively, the powder may be mixed into food at a rate of 50 g twice daily over 3 days leading up to hard work.

Summary: In Endurance, energy production is primarily aerobic (using oxygen); fats and glycogen are the dominant fuels. Fats are the desired major energy source so that glycogen is spared for high intensity work periods of an event - see Equine Series No. 2 (L-Carnitine).

Ammonia:

Ammonia is a waste product of muscle work that accumulates in the body during all aerobic and anaerobic exercise. Ammonia is toxic to all cells, reduces the formation of the energy source glycogen, and disrupts the energy cycle. The higher the blood ammonia, the poorer the performance.

TRIPART - Fuel and Protect

Amino acids & essential cofactors to optimise muscle metabolism



30 mL & 250 mL paste; 100 mL sterile injection

TRIPART contains aspartates, involved in the reduction of blood lactate & ammonia; arginine & lysine to promote muscle healing & repair; and selenium as an antioxidant. **TRIPART**, by promoting efficient energy conversion, may help to improve muscle endurance & delay fatigue. Tripart can be given daily for 2 - 3 days prior to hard work to reduce the risk of Tying Up in long, hard events. Also ideal to use before and during long-haul transport to protect muscles.

UNTIE - Damage Control for Muscles

4 kg & 10 kg buckets



UNTIE is particularly useful for horses that regularly Tie Up during hard rides. This daily powder supplement contains Selenium & Vitamin E, and a balanced supply of the most critical electrolytes, plus natural antioxidants for muscle cell protection.

The nutrients may assist oxygen supply to muscles, aid glycogen metabolism and help reduce the tendency to Tying Up. **UNTIE** works well as a daily preventive supplement, and is commonly combined with TRIPART leading up to an important event. It can also be safely administered with Green Amino Powder and / or Cophos B.

Oxygen:

Oxygen supply to muscles and brain is vital for performance. Oxygen is important for all aerobic exercise, particularly endurance work where the goal is to exercise at a moderate even intensity with minimal use of anaerobic energy sources. Optimum supply of oxygen is vital, and can be assisted by supporting the production of haemoglobin (the red pigment which carries oxygen in red blood cells). By encouraging optimum haematocrit ("blood count" or Packed Cell Volume), oxygen supply to all cells is also optimised. Blood cells and haemoglobin are built in the bone marrow using a balanced variety of nutrients, including iron, copper, and B vitamins.

VAM - Replace & Build

30 mL, 250 mL pastes;
100 ml sterile injection;
freeze-dried chewables



VAM is a supplement of the vital nutritional cofactors required in large amounts during exercise and stress. It contains minerals, vitamins and amino acids necessary for maintenance of red blood cell production, hence the support of healthy red cell counts. Additionally, **VAM** supports carbohydrate metabolism for energy production and provides high turn-over vitamins for general health.

Post event recovery, also a very important subject, is covered in our Equine Series No. 5 brochure.

Paste formulations are a valuable alternative to injections. They don't intimidate the horse or create needle trauma, are readily absorbed, and allow for accurate dosing.

Available at:
all leading equine supply stores.

Proudly manufactured in Australia by:



For further information on the Nature Vet product line,
Telephone toll free: 1800 624 174
Email: info@naturevet.com.au
Web: www.naturevet.com.au

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Muscles, Endurance & Performance

This pamphlet was compiled by Dr. J McLeod, B.V.Sc, and Mark Day, to help trainers better understand the demands of modern horse competition, and how to meet these demands by using the Nature Vet product range economically and successfully.