ST DAVID'S EQUINE
VETERINARY SURGEONS

ST DAVID'S EQUINE
FACTSHEET

Equine fitness

The horse has undergone millions of years of selective breeding to produce an anatomy and physiology to allow it to run away fast and to cover many miles to find food. Anatomically these adaptations include lengthening of the leg, reduction in the number of digits and loss of the collar bone. Physiological adaptations have enabled greater oxygen delivery to the muscles and a greater ability to use the available oxygen at the sites it is needed the most.

Below is a table of comparisons between the horse and the human athlete.

	Horse %of body wt	Human %of body wt
Heart	1.1% 220L/min best 550L/min A barrel holds 247L!	0.5%
Spleen	1% Can hold 12L of RBC	0.3%
Lungs	1.5%	1.4%

Improving Performance and Fitness in the Short Term

There is not a lot you can do to improve your horses anatomy as once it is adult its leg length is not going to change however much training you do! However, both the physiological parameters and muscle mass can be adapted by training and endurance can be helped with a good knowledge of nutritional needs and training schedules.

In the short term the best thing that can be done to increase performance is a good warm up. This has the effect of raising the body temperature which increases the speed the enzymes can breakdown fuel reserves, increasing blood pressure (which has the effect of opening up blood vessels particularly in the lungs allowing better oxygenation of the blood), increasing the elasticity of the skeletal system, and increasing circulating plasma volume and circulating red blood cells partly aided by the contraction of the spleen.

Longer Term Improvements

Training must be tailored to the discipline that the horse competes in. Obviously to improve the performance of sprint horses we will need to work on improving maximal speed and increasing the anaerobic capacity of the muscles. In contrast, endurance animals and will not need to train at maximal speed but need

to increase the aerobic capacity of the body. For the muscles to adapt to training they need to be stressed and subjected to periods of hypoxia (periods of reduced oxygen) this will stimulate the genes to produce more enzymes and proteins. The most important part of any training schedule is adequate rest between strenuous exercises. This is just as important as the exercise itself and is often overlooked. For example after using up glycogen (the stored energy source) in the muscles it can take 3 days to replace (although this can be speeded up by giving intravenous glucose infusions). It takes 10 days to repair muscle damage and 24-36 hours to replace any fluid lost due to sweating.

Effect of training on the horse

Heart wt	10% increase
Capillary density in muscles	36% increase
Enzyme capacity	100% increase
Lactate levels	51% decrease
Plasma vol	30% increase

Effect of feeding the horse.

- Muscle glycogen (the stored quick release energy source) cannot be increased with training in the horse as it is already at a maximal level.
- Carbohydrate loading is not beneficial and can often be detrimental as it can result in increased muscle pH (acidity), decreased lipolysis (breakdown of fat for energy) and reduced release of glucose from body stores.
- Neither has there been shown to be any beneficial effect of feeding high levels of protein.
- The only elements of the diet that can increase run time to fatigue is to increase the fat and fibre content of the diet, along with electrolyte supplementation

All these factors work together to allow a greater oxygen delivery to the muscles increasing performance and run time to fatigue.

Types of fatigue

Anaerobic fatigue

This occurs due to the breakdown of energy without the use of oxygen and is required in high power short sprints. As a by product of anaerobic metabolism lactic acid is produced, this raises the pH (acidity) in the muscles and blood which inhibits muscle contraction. The horse has a large capacity for absorbing lactic acid and can tolerate much higher levels than a human and this capacity can be increased by training. The measurement of lactic acid in the blood is a good indicator of levels of fitness and can be used as an indication of the success of your training regimes.

Aerobic fatigue

This occurs when the amount of oxygen is sufficient but fuel reserves run out, supply cannot meet demand, and/or fluid/electrolyte loss is high enough to reduce the circulating blood volume. Training alters the body to allow more efficient release of fat reserves and their quicker conversion to usable energy for the muscles

Signs of fatigue

- Reluctance to exercise.
- Muscle soreness.
- XS Sweating.
- Decreased appetite.
- Decreased thirst.
- Flared nostrils for long time after finish of ex. High resp rate.

If these signs are ignored or missed and work is continued without the proper treatment then it can lead to exhaustion.

Signs of clinical exhaustion

- Depression/distress/abnormal behaviour
- Increased rectal temp >41C
- Persistently raised heart rate >60bpm
- Thumps (diaphragmatic flutter. Looks like hiccups)
- Muscle fasciculation's
- Colic
- Heart arrhythmias
- Dehydration

Clinical exhaustion can be a potentially life threatening condition, and recovery will take a prolonged period and certainly put back any training schedule.

Avoiding exhaustion entails a combination of adequate fitness for the sport undertaken, early recognition of fatigue, and electrolyte supplementation both before during and after the event.

Electrolytes

A horses sweat is isotonic with (the same concentration as) blood plasma (unlike humans whose sweat is hypotonic (lower concentration than plasma)). This means that in the horse much more "salt" is lost in sweat. For the equine it has been calculated that over a 2 hour period of moderate exercise the horse will lose 20L of fluid 58g sodium, 106g Chloride, 27g potassium. This has the effect of decreasing the circulating blood volume and causes overheating because the cooling effect of the circulating blood is lost. The loss of chloride ions (part of salt) has the effect of making the blood alkaline, which also contributes to fatigue.

Just replacing water alone can make the situation worse and in some cases has even caused acute death of the animal as the water absorbed will further dilute down the remaining electrolytes in the blood which can cause heart irregularities. Also the horse will not have a great thirst as the circulating fluid is still at the correct concentration and this fools the brain into assuming it has enough fluid. As the saying goes you can take a horse to water……..

To overcome this problem we supplement with electrolytes. This stimulates thirst and replaces the lost electrolytes. Electrolytes are best supplemented in the normal feeding regimes (for moderate exercise e.g. Hunting or eventing the horse will need 25g salt per 100kg body weight per day). On the day of the event a balanced electrolyte solution should be given. This can be homemade (1 tablespoon of salt + 1 tablespoon low salt in four litres of water). It is best to train the horse to drink this kind of fluid before you get to the event. For endurance riders carrying this amount of fluid around with them is impractical so a concentrated commercial electrolyte paste is often given to stimulate thirst and increase the intake of water while competing.

A horse is unlikely to drink cold water when exercising but can often be encouraged to take warm water. If the animal is severely fatigued or exhausted then they will not drink no matter how dehydrated. In this case the vet is needed to give the extra fluids. The preferred method is to give this by stomach tube (electrolyte solution, not pure water) or if necessary by the intravenous route.

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