

Equine feeding for health, wellbeing and performance

Dr C.E. Foote
Equine Consulting Services



Is your horse meeting its full potential?

All horses are governed by their “genetic” potential to perform, and often as owners and trainers, there is little you can do about the breed or genetics of the horse you are working with. However, through appropriate training and adequate nutrition and care of your horse, you can ensure that he or she *performs at the very best of his or her ability* every time.

Nutrition is the easiest thing to control.

There are certain nutrients required for frequent or prolonged physical activity. These include:

1. Water (a loss of only 15% body water is fatal)
2. Body salt or electrolytes
3. Energy, protein, vitamins and minerals



Energy for physical performance

Energy is required to fuel the body processes including muscle contraction and provide heat to maintain body temperature. The energy needs of a horse are influenced by the speed and duration of the exercise, the horse's temperament, the weight of the rider and the horse, the type of working surface and the general metabolic efficiency of the breed or individual animal.

The adequacy of the energy intake in a working horse can directly influence the horse's performance, its vitality, and maintenance of an optimum body condition.

The energy requirements of a horse increase with an increasing workload.

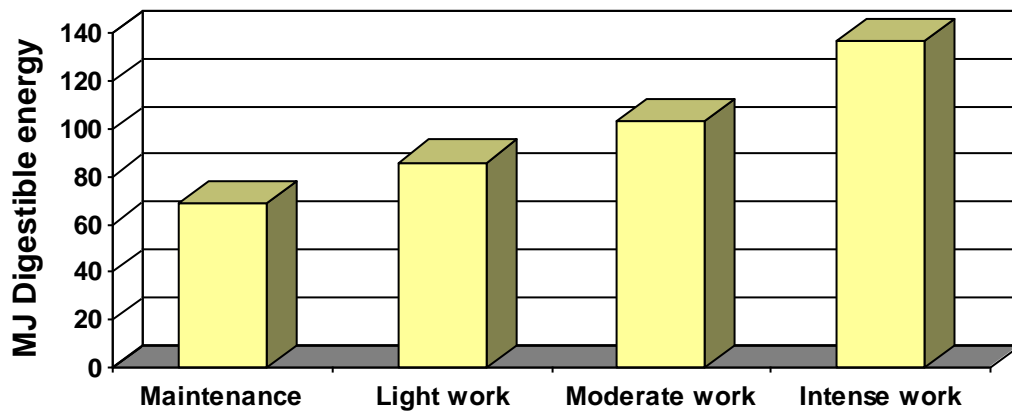
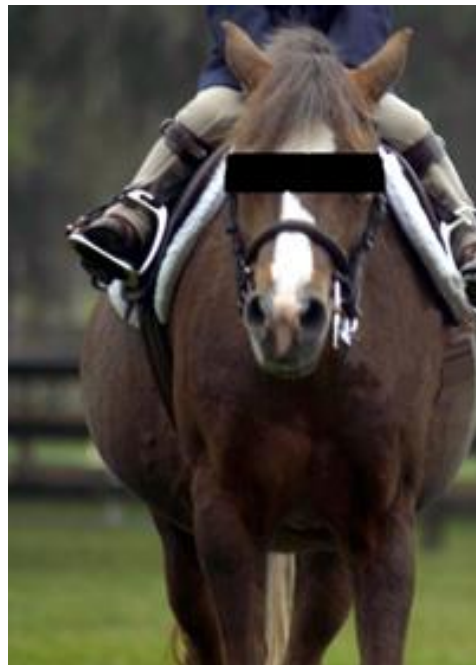


Fig 1. Graphical description of the increased requirement for energy as the workload of horses increases (Kohnke *et al.*, 1999).

If the amount of energy provided in the horse's diet is in excess, the horse will channel the surplus energy into activity, making it "hyper-energetic", "above itself", "fizzy" or more difficult to handle.

In a quieter horse, it will be converted into body fat.

Inadequate energy in a horse's diet will affect the animal's ability to exercise, grow or reproduce and the horse will lose body weight as fat and protein will be utilized to maintain daily energy needs.



Sources of energy

Sources of energy include the cereal grains (e.g. oats, corn, barley) and oils.

Table 1. Advantages and disadvantages of oats, corn and barley

Grain	Advantages	Disadvantages
Oats	Renowned as a “safe” grain. Has a high crude fibre content which dilutes the starch content reducing risk of digestive upset and laminitis if excess is fed relative to needs. Contains the lowest amount of starch but highest proportion of starch digested in small intestine. While crimping, rolling and grinding oats do not improve digestibility, they may improve palatability particularly for growing foals and older horses.	Of the grains, oats has the lowest digestible energy content which increases the amount that has to be fed. There is also the suggestion that it may lead to “tying-up” in some horses. May lead to nervy, hyperactive behaviour in some horses.
Corn	Energy dense grain. Contains twice as much energy as oats on a volume basis and about 18% more digestible energy on a weight basis.	Not well digested in small intestine. Overloading of starch into hindgut increases risk of D-lactic acid build-up, which can trigger the onset of laminitis and founder, as well as low grade diarrhoea and excitable behaviour. Aim to feed no more than 250g/100kg body weight.
Barley	Energy levels mid way between oats and corn. Known as a “conditioning” feed possibly due to high levels of chromium. Widely used in standardbreds and eventers.	Whole raw barley is harder and less palatable than oats. Low starch digestibility (Boiling at a simmer for 10-15mins improves digestion of starch in small intestine as compared to rolling or steam flaking, now available in roasted and extruded form).

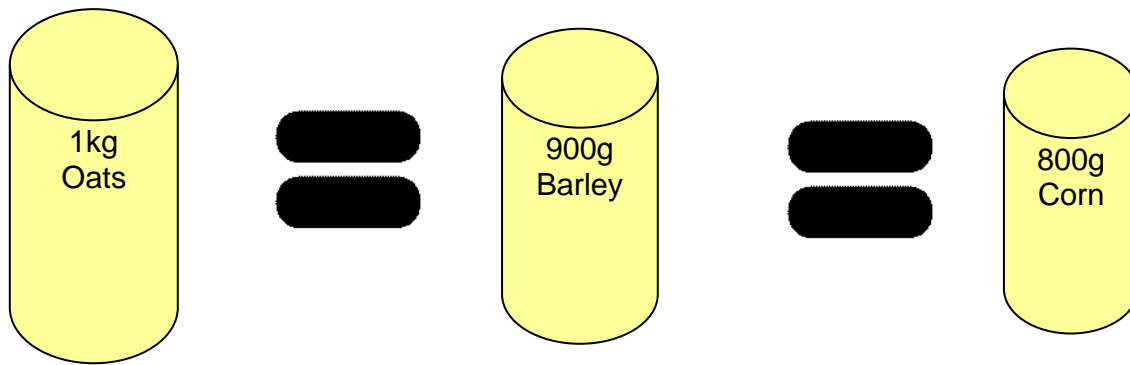


Fig 2. Comparison of energy levels of grains

Fat as energy

Body fat stores can be drawn upon during prolonged exercise, particularly useful for horses involved in endurance type activities. These are broken down to free fatty acids which are then aerobically metabolised to energy in working muscles. Fats cannot be converted to glucose and used during fast anaerobic exercise in athletic horses.

There are several benefits to feeding fat in the diet. These include:

- Concentrated energy source
- Improves body condition and coat
- Increases energy without increasing bulk
- Decreases heat produced from digestion of grains
- Lower lactic acid accumulation in muscles and blood by sparing glycogen use
- Reduced severity of tying-up
- Reduced muscle damage
- Calmer behaviour in horses on typically high grain diets

Omega-3 and Omega-6

Each oil or fat has a blend of different fatty acids (Omega-3, Omega-6) in its triglyceride content and a correct ratio of these is essential. Oils that contain higher amounts of Omega-3 are considered to provide natural anti-inflammatory compounds and hormone action to improve the function and strength of blood vessels and body cells

In animals, an Omega-3 to Omega-6 fatty acid ratio of 1 part Omega-3 to 5-10 parts Omega-6 is considered beneficial.

Please refer to article entitled “The benefits of feeding oil as part of a horse’s ration” for further information.

Table 2. Comparison of oils commonly used in horse feeds

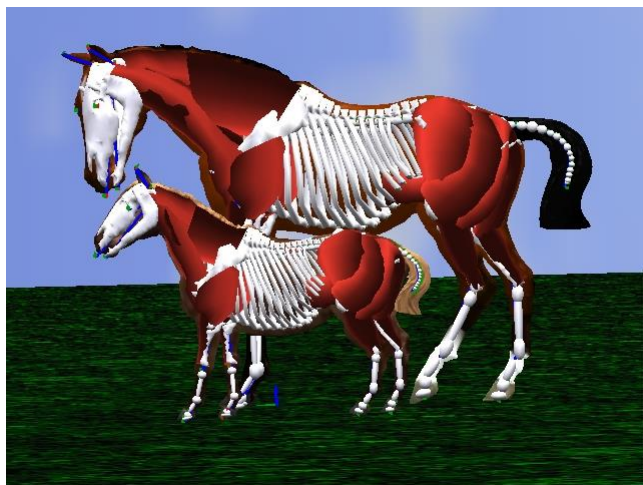
Oil	% of Fatty Acids in Oil		Comments
	Omega 3	Omega 6	
Canola oil	10	20	Palatable, well accepted, cold pressed is stable, less risk of oxidation.
Soyabean oil	8	54	Reasonably well accepted, some Omega-3, but high content of Omega-6.
Corn oil	2	52	Low Omega-3, not as palatable, more easily oxidized.
Sunflower oil	< 1	66	Palatable. Contains high levels of Omega-6 for coat conditioning but very little Omega-3.
Blended polyunsaturated cooking oil	1-5	45-60	Ratios depend on blend of oils. Canola blends contain higher Omega-3 fatty acids.

Protein

Protein is the major structural component of muscles, blood and many other tissues. On a moisture and fat free basis, protein constitutes 80% of a horse's body weight. Proteins primarily provide amino acids and nitrogen for tissue growth.

A horse needs a daily intake of protein to maintain, grow and repair tissues, however, unlike energy which is stored as glycogen or fat, excess protein is not stored in the body. This means it is pointless (even in young growing horses) to feed any more protein than is recommended, it will simply add cost to your feeding program.

If there is not enough protein in the diet, there will be a breakdown of protein contained in muscle and the horse will lose condition. Higher protein requirements are indicated in working horses to replace tissue degradation and losses in sweat and in lactating mares due to the protein being secreted into the milk. Excess protein in the diet is fermented in the hindgut, producing heat, which adds to the heat load of exercising horses. This basically means that excess protein isn't good for horses that sweat as it increases the demand for water.



Sources of protein

All feeds contain protein but major protein sources include

- Lucerne hay/chaff (17%)
- Oil seed
 - Soyabean meal (45%)
 - Cottonseed meal (41%)
 - Linseed meal (35%)
 - Lupin seeds (34%)
 - Tick Beans (26%)
 - Sunflower seeds (23%)
 - Copra meal (22%)
 - Yeast (50%)

Please refer to article entitled “Protein quality and requirements in exercising and growing horses” for further information.

Minerals and Vitamins

Dietarily, minerals and vitamins should be regarded as a group rather than individually. As the intake of a mineral increases above that needed, the amount absorbed and/or excreted in the urine and/or faeces also increases. An excess amount absorbed may be harmful. That not absorbed may bind other minerals, decreasing their absorption and possibly resulting in a deficiency of these minerals.

It is the balanced amount of all minerals in the diet that is important. Indiscriminately adding one or even several minerals to the diet is likely to be more harmful than beneficial. Therefore, minerals should not be added to the diet unless it is known which ones and how much are needed.

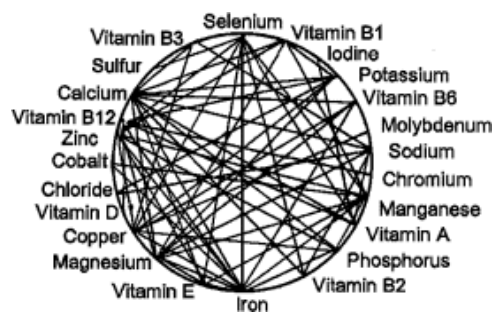


Fig 3. The interaction of vitamins and minerals

Sources of Minerals and Vitamins

Most feeds contain some minerals and vitamins but whether these feeds contain ENOUGH will be determined by the level of activity of the horse.

A description of the role and importance of some of the minerals and vitamins in equine performance are shown in Tables 3a and 3b on the following pages.

Table 3a. Brief description of the role and importance of some of the minerals and vitamins in equine performance.

Mineral	Role/Importance
Calcium	Critically involved in bone growth, development and maintenance. Should be maintained in an appropriate balance to phosphorus. Deficiencies result in bone deformities/skeletal weakness, joint problems, may lead to muscle weakness and conditions such as “tying up”, and the “thumps” in heavily sweating, exhausted horses.
Phosphorus	A deficiency in phosphorus can result in retarded bone formation, retarded growth, poor appetite, infertility and poor conception and lowered milk production.
Sodium	Essential for normal growth. Key electrolyte in all performance animals. Critically involved in normal nerve and muscle function, and carbohydrate digestion. Sodium is often inadequate in diets.
Magnesium	Important electrolyte in muscle contraction, body fluids and metabolic enzymes.
Potassium	Involved in nerve and muscular function. Deficiencies can result in a reduced appetite, retarded growth, weight loss, and dehydration.
Sulfur	Essential for healthy hair, skin and hooves. Involved in oxygenation of the brain to maintain oxygen balance and works closely with B vitamins for many basic metabolic functions. Is part of many essential amino acids.
Iodine	Incorporated into the hormone thyroxin in the thyroid gland with regulate the metabolic rate. Deficiency can reduce metabolic rate and exercise tolerance. In recent years, iodine toxicosis in horses has been much more frequently reported than iodine deficiency. Iodine toxicosis may occur as a result of feeding seaweed (kelp). Seaweed may contain as much as 1850mg/kg of iodine, at which level more than 20g of it per horse per day would be harmful.
Zinc	Essential in bone, cartilage and hoof formation. Deficiency can result in reduced appetite, retarded growth, dry thickened skin and hair loss in severe deficiencies.
Copper	Required for the development of bone, joint cartilage, elastic connective tissue, uptake and utilization of iron and copper containing metabolic and tissue anti-inflammatory enzymes. Deficiency can result in lameness in growing horses and anaemia.
Manganese	Contributes to carbohydrate and fat metabolism and formation of chondroitin sulfate in cartilage of joints.
Cobalt	Integral in synthesis of the Vitamin B12 and is involved in the formation of the oxygen carrying component of red blood cells. A deficiency can result in anaemia.
Selenium	Deficiency can result in poor muscle development and pale, weak muscles (White muscle disease) in foals on deficient diets. Can also result in poor performance in racing horses, and may predispose to “tying-up”, lower fertility in mares.

Table 3b. Brief description of the roles and importance of some of the vitamins in equine performance.

Vitamin	Role/Importance
Vitamin A (β -carotene Retinol)	Fat soluble natural vitamin essential for growth processes. It is required for visual pigments in eyes, bone remodeling, tendon strength, health of skin and mucus membranes. Deficiency results in progressively poor night vision, loss of appetite, poor growth, infertility in mares (older mares more affected), reduced tendon strength, and a higher risk of respiratory infections.
Vitamin D (Ergocalciferol Cholecalciferol)	Critically concerned with the absorption, regulation, metabolism and excretion of calcium and phosphorus. Deficiency depresses calcium uptake and can lead to abnormal gait, lameness, weak bones and swollen joints.
Vitamin E (α -Tocopherol)	Essential fat-soluble vitamin and has an antioxidant activity to protect against oxidation of compounds in food, and within fats in membranes of muscles and body tissue. Has an antioxidant function and supplementation has been shown to improve track performance in racehorses. It is recognized as a compound which dilates capillaries and preserves capillary walls. It is also known to increase cardiac efficiency significantly, and reduce lactic acid production.
B Group Vitamins	B Group vitamins play a role in the release of energy, and are needed for numerous essential body functions. Symptoms of deficiencies of B Group vitamins include loss of appetite, abnormal heart beat, muscle tremors, in coordination, stiffness in limbs and lung fluid build-up. In diets consisting largely of cereal grains, protein meals, chaff and dried hays, natural forms of B Group vitamins are generally in short supply. Injections do not elevate blood levels for very long and supplementation is best given in the feed.

Inadequate energy, protein, vitamin and mineral levels are best diagnosed and corrected by evaluation of rations. This involves weighing out each of the ingredients in a ration and a nutritionist is then able to compare the nutrient levels in the ration as a whole to the recommended nutrient levels of the particular horse at its particular level of activity.



Design of rations

There are many ways to feed horses, whether it be by using complete premix feeds, or using basic grains to mix your own. There is not necessarily any correct way to feed, often it comes down to what is logistically possible for your circumstance. It may be more cost effective to mix your own grains, however if you only have a small number of horses, having several ingredients and several feed bins may prove an arduous task. No matter how you feed, it is not only vitally important to ensure you have an adequate level of energy, protein, vitamins and minerals but that they are also provided in appropriate balance to one another.

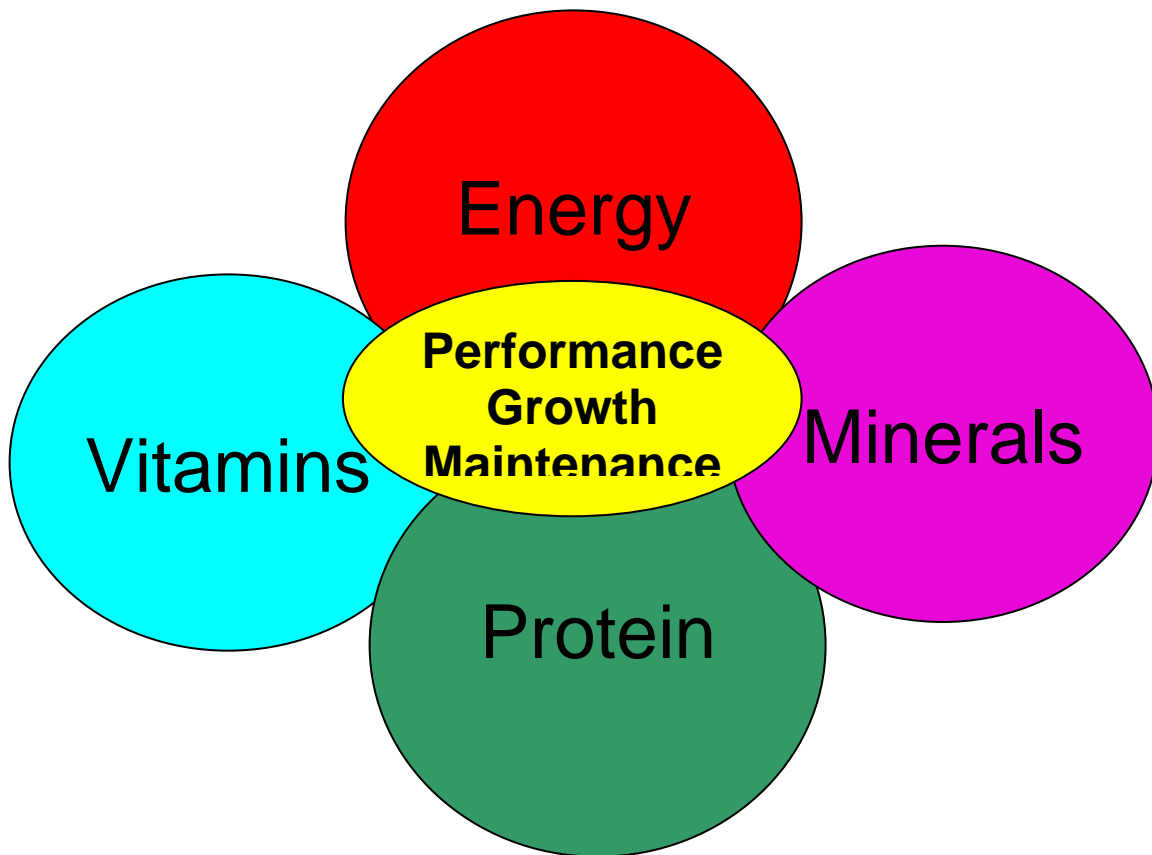


Fig 4. For performance, growth and maintenance, all horses need not only an adequate amount of energy, protein, vitamins and minerals, but they all must be provided for in an appropriate balance to each other.

When is supplementation necessary?

Supplementation of minerals and vitamins may be indicated

- If horse involved in any high intensity activity
- If pasture inadequate
- If horse not consuming adequate amounts of a premix ration
- If want to reduce amount of hard feed offered
- If horse is stressed by environmental conditions (e.g. heat, humidity)

Roughage

Roughage is an extremely important part of the horse's diet, particularly for the endurance horse. It opens up the digestive mass and traps water to aid soluble nutrient uptake, facilitates controlled fermentation to provide volatile fatty acids for energy synthesis of B Group vitamins, generates heat during fermentation to maintain body warmth and stores a reserve of fluid in the hindgut that can be absorbed as a horse dehydrates due to sweat, respiratory and urinary loss.

It is recommended that horses which do not have full time access to adequate pasture should be provided with a minimum amount of roughage as hay/chaff equivalent to 1% of their body weight per day. This equates to approximately 5kg roughage for a 500kg horse. A biscuit of hay weighs roughly 2kg, so that equates to 2 biscuits of hay and 1kg of chaff (as a rough guide) per day.

Table 4a and 4b describes the relative energy, protein and mineral levels of various types of roughage.

Table 4a. Average energy and protein levels of lucerne, oaten, meadow and wheaten hay

	Energy (MJ/kg)	Protein (%)
Lucerne	8.5	17
Oaten	7.5	9
Meadow	7.3	10
Wheaten	7	8

Table 4b. Average calcium and phosphorus levels of lucerne, oaten, meadow and wheaten hay

	Calcium (g/kg)	Phosphorus (g/kg)
Lucerne	12.2	2.2
Oaten	2.2	2.3
Meadow	6.8	2.2
Wheaten	1.3	1.8

* For horses working for extended periods of time, it is advised to not provide excessive amounts of calcium. It is considered that high intakes of lucerne above 4kg daily provides excess calcium which suppresses parathyroid gland function and the subsequent mobilisation of calcium from bone stores during a ride when sweat output depletes blood calcium. Reduced blood calcium can result in muscle weakness and a risk of "tying up" and the "thumps".

- **Poor hair coat/hair loss**
 - **Weakness, lethargy, fatigue listlessness**
 - **Ataxia, “wobblers”**
 - **Blindness**
 - **Lameness**
 - **Stiff Movement**
 - **Hoof defects or slow growth**
 - **Developmental orthopaedic diseases**
 - **Diarrhoea**
 - **Constipation**
 - **Colic**
 - **Dehydration**
 - **Excess licking**
 - **Teeth mottled/pitted**
 - **Pica**
 - **Polyuria**
 - **Hematuria**
 - **Haemorrhaging**
 - **Muscle tremors**
 - **Convulsions/seizures**
 - **Impaired immunity**
- **Dyspnea, increased respiratory and/or heart rate**
 - **Anaemia**
- **Born dead, weak, or with bone abnormalities**
 - **Nursing difficulty**
- **Subcutaneous swelling and/or oedema**
 - **Excess lacrimation**

Fig 5. While these symptoms are likely to be multifactorial, a nutritional deficiency or imbalance has been shown to cause each of the symptoms above.

What happens if the diet is inadequate?

Not providing all of the nutrients a horse needs for its level of activity will

COMPROMISE PERFORMANCE

COMPROMISE WELLBEING

Much of the information presented in this article was sourced from the following references:

Frape, D. (1998). *Equine Nutrition and Feeding*. Blackwell Publishing, UK.
 Kohnke, J.R., Kelleher, F., Trevor-Jones, P. (1999). *Feeding Horses in Australia*, RIRDC Publication No 99/49.
 Lewis, L.D. (1995). *Equine Clinical Nutrition*. Williams & Wilkins, USA.