

Vitamin E

An important fat soluble vitamin in the Equine diet

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Vitamin E is a fat soluble vitamin that performs a very important antioxidant function within the body. Vitamin E forms part of the horses' strong antioxidant defences, which are needed to reduce the formation of damaging substances called free radicals or reactive oxygen species (ROS). Although ROS are produced as a normal consequence of metabolism, their production may be increased during exercise, with disease and as part of the body's inflammatory response to injury. Antioxidants including vitamin E are important both to reduce the quantity of ROS produced, but also to limit their damaging effects on the body once formed.

Vitamin E is lipophilic, which means that it can easily associate itself with cell membranes to function here as an effective antioxidant. Vitamin E helps to protect the components of cell membranes, which includes unsaturated lipids from being damaged through oxidation. Vitamin E works closely with other antioxidant enzymes such as glutathione peroxidase as well as vitamin C to limit antioxidant damage.

Vitamin E form

Vitamin E actually refers to a group of similar naturally occurring compounds known as tocopherols and tocotrienols of which there are four of each α , β , γ , δ . These compounds are found naturally in feed ingredients and therefore there are many sources of vitamin E in horse feed. Within the horses diet, fresh forages such as grass, hay or alfalfa have the highest natural content of vitamin E (30-100IU/kg dry matter), especially when they are at an early stage of growth. In contrast, the level of vitamin E activity found in cereals tends to be lower (23-30IU/kg dry matter) (NRC 2007). The level of natural vitamin E in feed and forages decreases during storage and so most manufactured feeds are fortified with extra vitamin E, as part of a broad spectrum vitamin and minerals premix. Most often a synthetic form of vitamin E known as α -tocopherol acetate is used. However, the natural form of vitamin E remains an important part of the diet, as research suggests that natural vitamin E is more effectively absorbed and leads to higher circulating levels of vitamin E in the blood (Gansen et al. 1995; Pagan et al. 2005).

Vitamin E deficiency

The importance of adequate levels of vitamin E in the diet is highlighted by the implication of low vitamin E status with a number of muscle related diseases:

- White muscle disease – a degenerative disease of skeletal & cardiac muscle
- Equine Motor Neurone disease – a neurodegenerative disease
- Equine degenerative myeloencephalopathy - a degenerative disease of the spinal cord
- Equine rhabdomyolysis (tying up / set fast) – a metabolic disease of muscle

Vitamin E requirements

The National Research Council (NRC 1989) suggests a minimum dietary requirement for vitamin E of 80IU/kg dry matter per day, which is equivalent to about 1.6IU of vitamin E / kg bodyweight per day. However, this level of intake should certainly be regarded as the minimum level required and a higher intake has been advocated to maximize tissue stores of vitamin E (1.4 – 4.4IU vitamin E / kg bodyweight per day (Roneus et al. 1986). Other authors have suggested 4IU/kg bodyweight per day for pregnancy, lactation and growth and 6.25IU/kg bodyweight per day for performance horses, assuming a daily dry matter intake of 2.5% of bodyweight (Harris and Naylor 2001) .

The popularity of high oil containing feeds also means that an optimum intake of vitamin E is essential. Feed supplemented with soya and corn oil, which has a high polyunsaturated fatty acid content, may be inclined to reduce the body's vitamin E status as more vitamin E is required to stabilize the component polyunsaturated fats. Additionally in horses, high oil containing diets have been shown to promote oxidative metabolism during exercise (Orme et al. 1997), which may increase the production of ROS. Nutritionists have previously suggested that 100IU of additional vitamin E is added for each additional 100ml of oil fed per day (Harris 1999).

Vitamin E Supplementation

Vitamin E has very wide ranging functions within the body and outside of its antioxidant function it has been shown to be important with respect to immune function, particularly in young horses. The foals of mares fed vitamin E at 160IU/kg dry matter per day had improved circulating antibodies (IgG) compared to those foals of mares fed vitamin E at the lower NRC recommendation (80IU/kg dry matter per day) (Hoffman et al. 1999).

Exercise training is also thought to increase the requirement for vitamin E, as vitamin E status is reduced in trained versus untrained horses fed an inadequate vitamin E containing diet (Petersson et al. 1991), whereas there is no difference between trained and untrained horses with additional vitamin E supplementation. Higher intakes of vitamin E (6IU/kg body weight), above that advocated by NRC 1989, appear to be required to maintain vitamin E levels in both blood and muscle during more intensive exercise (Siciliano et al. 1997). It has also been shown that supplementation with vitamin E may also offer some protection against exercise induced muscle damage as a higher intake of vitamin E is associated with a reduction in the muscle enzymes AST

and CK in blood, which are generally regarded as an indicator of muscle damage (Williams et al. 2003).

Vitamin E therefore has a wide role to play in the diet of all types of horses from youngsters through to performance horses. It is important to ensure an adequate and appropriate level of vitamin E in the diet by offering good quality forage and also feeds or supplements that are well fortified with vitamin E.

References

- Gansen, S., A. Lindener, et al. (1995). Influence of a supplementation with natural and synthetic vitamin E on serum α -tocopherol content and v4 of Thoroughbred horses. Proc. of the 14th Equine Nutr.Physiol. Soc. Symp.
- Harris, P. and J. M. Naylor (2001). Nutrition. Equine Veterinary Nursing manual. K. Coumbe. Oxford, Blackwell Science: 101-125.
- Harris, P. A. (1999). Feeding and management advice for tying up/azoturia/monday morning disease/equine rhabdomyolysis syndrome etc. Proceedings of the BEVA specialist days on behaviour and nutrition, Harrogate, Equine Veterinary Journal Ltd.
- Hoffman, R. M., K. L. Morgan, et al. (1999). Dietary vitamin E supplemented in the periparturient period influences immunoglobulins in equine colostrum and passive transfer in foals. 17th Equine Nutr. Physiol. Soc. Symp. Raleigh.
- NRC (2007). Vitamins. Nutrient Requirements of Horses 6th Edition. Washington DC, The National Academies Press: 109-127.
- Orme, C. E., R. C. Harris, et al. (1997). Metabolic adaptation to a fat-supplemented diet by the thoroughbred horse. British Journal of Nutrition **78**(3): 443-458.
- Pagan, J. D., E. Kane, et al. (2005). Form and source of tocopherol affects Vitamin E status in Thoroughbred horses. Pferdeheilkunde **21**(SUPPL.): 101-102.
- Petersson, K. H., A. H. Hintz, et al., Eds. (1991). The effect of vitamin E on membrane integrity during submaximal exercise. Equine Exercise Physiology 3. Davis, California, ICEEP Publications.
- Roneus, B. O., R. V. Hakkarainen, et al. (1986). Vitamin E requirements of adult Standardbred horses evaluated by tissue depletion and repletion. Equine veterinary journal **18**(1): 50-58.
- Siciliano, P. D., A. L. Parker, et al. (1997). Effect of Dietary Vitamin E Supplementation on the Integrity of Skeletal Muscle in Exercised Horses. Journal of Animal Science **75**(6): 1553-1560.
- Williams, C. A., D. S. Kronfeld, et al. (2003). Vitamin E intake and oxidative stress in endurance horses. . Proc. 18th Equine Nutrition and Physiology Symposium.