

Oversupplementation

with Dr Jennifer Stewart



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So let's firstly have a quick summary of the reasons for supplementing, and then explore different supplements and potential dangers.

Horses are subject to poisoning from many sources. Cases of mineral intoxication have been due to prepared feeds contaminated during manufacture; accidental addition of excessive minerals at the feed mill; use of minerals contaminated with unwanted elements, or the addition of the wrong supplement. And, although our motivation to provide dietary supplementation is nearly always an honest desire to provide the best nutrition available, unwise use of supplements can also cause a range of intoxications.

Most feed rooms sport a collection of powders, pots, pellets and plastic scoops and a rainbow of supplements from natural, herbal botanical extracts to high-tech, high-performance formulations. The choice of supplement is nearly always based on advice from friends and colleagues and gut feelings - but what works for one horse in one situation won't necessarily work for another. So let's firstly have a quick summary of the reasons for supplementing, and then explore different supplements and potential dangers.

Although the main component of any horse's diet should be forage, rarely does it provide a balanced diet – even for maintenance – and additional nutrients may be required. These are intended to increase energy or protein intake, or provide recommended levels of micro- or macro-

nutrients. In other situations, targeted supplementation is used to address a particular clinical issue or performance goal. When referring to diet supplementation, its definition therefore can change depending on the particular aim of the supplementation. 'Specialized supplements' have a specific goal — such as trying to improve performance, prevent a problem from occurring or manage a problem after it arises. 'Neutraceutical' comes from the words 'nutra' meaning nutrient and 'ceutical' meaning a medical drug. 'Herbal medicine', also known as 'phytomedicine', is the use of plants, plant parts or plant-derived substances to aid in resisting infections or diseases, or to support general health and well-being.

Over-supplementation can cause problems. A balanced diet is the fundamental starting point to ensure basic dietary needs are met. But feeding beyond requirements makes expensive manure – and can be dangerous. Table 1. Lists common minerals and vitamins that can damage health if provided in excess of requirements. Oversupplementation with selenium and iodine are the most commonly reported causes of dietary toxicity in horses. In foals, iron toxicity has been induced by administration of iron fumarate; and excess mineral intake and toxicity have also been reported due to contamination of soil with zinc and of phosphate with fluorine.



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TABLE 1. SUPPLEMENTS - TOXICITY OF INDIVIDUAL MINERALS

Nutrient	Max Safe Total Daily Intake 1,2
Aluminium	1.5g per kg of total daily feed
Boron, nickel, vanadium	Supplementation can be dangerous
Calcium (Ca)	2% of diet (if P requirements met) = 20g per kg of total daily feed
Chloride (Cl)	6% of diet as salt = 60g per kg of total daily feed
Cobalt (Co)	10mg per kg of total daily feed
Copper (Cu)	800mg per kg of total daily feed
Fluorine (F)	40mg per kg of total daily feed
Iodine (I)	5mg per kg of total daily feed
Iron (Fe)	2g per kg of total daily feed
Magnesium (Mg)	0.8% of diet = 8g per kg of total daily feed
Manganese (Mn)	1g per kg of total daily feed
Molybdenum	20mg per kg of total daily feed
Phosphorus (P)	1% (if Ca requirements met) = 10g per kg of total daily feed
Selenium (Se)	2mg per kg of total daily feed
Sodium (Na)	3% of diet = 30g per kg of total daily feed
Sulphur (S)	1.25% of diet = 12.5g per kg of total daily diet
Zinc (Zn)	500mg per kg of total daily diet

It is so very important to consider and calculate the total daily intake – especially when using multiple supplements or supplements plus prepared commercial feeds. **‘Total daily intake’ is the mantra! Total daily intake: the sum of nutrients from every feedstuff consumed each day!**

Fluorine intoxication or fluorosis can occur from industrial contamination of pasture, hay or water or from supplements naturally high in fluorine. Phosphorus supplements (which should not contain more than 0.2%) vary from 0.01% in DCP to 4% for fertilizer-grade or raw rock phosphates. Signs of poisoning include weight loss; rough, dry coat; failure to fully shed winter coat; thickened skin; lameness and dental changes. Iodine is widely distributed in nature but in very small amounts.

Supplementation is often required and 30g of iodised salt meets most requirements. Problems of toxicity have occurred when kelp and other seaweeds are used unwisely; a single supplement is overused; several supplements are used together or combinations of prepared feeds and supplements are fed, without consideration of the total daily intake.

Iron is abundant in the surface of the earth and most plants meet requirements. Many supplements and feeds contain added iron. Iron supplementation is only justified in horses that have suffered severe blood loss. Iron intoxication and death from liver failure have been reported after intra-muscular injections of iron to adult horses and after oral administration to foals. Rickets has occurred in foals and yearlings grazing high molybdenum pasture in Ireland and signs resembled copper deficiency. Acute selenium intoxication (respiratory distress, diarrhoea and death) occurs in horses accidentally given excess supplementation or grazing selenium accumulator plants. A single oral dose of 3.3 mg of selenium per kilogram of body weight can be lethal but chronic poisoning (emaciation, hair loss and sloughing of the hooves) can occur when total daily intake provides 5-40mg/kg of feed. Zinc intoxication has occurred in horses grazing near smelters.

SUPPLEMENTS - TOXICITY OF INDIVIDUAL VITAMINS

Nutrient	Max Safe Total Daily Intake 1,2	Effects of Feeding Excess
Vitamin A (iu)	16000	Developmental bone disease in foals, skin damage, bone fragility
Vitamin D (iu)	2200	Calcification of soft tissue, death
Vitamin E (iu)	1000	Coagulation of blood, osteoporosis
1. total = sum of vitamins in everything fed		
2. Mineral Tolerances in Animals (NRC 2005)		

Most cases of vitamin intoxication have occurred due to improper use of supplements — excess use of a single supplement, multiple supplements, wrong dose or method of administration, or accidental addition of excessive amounts of vitamin supplements during feed formulation. Vitamin A supplements are commonly given because the carotene level in hay falls with storage. However, yearling ponies given 20 times the NRC recommended level suffered mild (depressed growth rate), and 200 times severe (ataxia, hair loss, skeletal abnormalities, liver damage) intoxication. Both vitamin D2 and D3 have caused intoxication in horses— although D3 is 10 to 20 times more so — with calcification of soft tissues, depression, weight loss, pain and stiffness, excessive drinking and bone resorption. Toxicity is enhanced by high dietary calcium and phosphorus and is reduced by low dietary calcium or dietary factors such as oxalate or phytate, which reduce calcium availability.

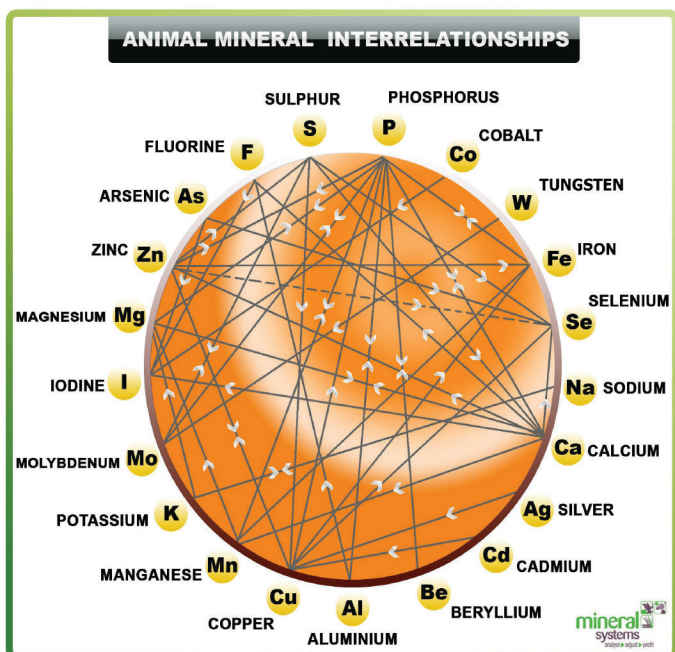
In addition is the complication, not yet fully validated in horses, of mineral and vitamin interactions. These interactions (figure below) make it difficult to determine an exact optimum dietary level for individual minerals, vitamins and elements. Mineral metabolism in the equine is a complex process involving absorption sites and interactions between the minerals themselves and other compounds. Interactions differ between species: studies in rat, rodents, calves and man, found that increasing magnesium intake led to no change in, an increased or a decreased calcium uptake! In horses, high dietary calcium does not affect magnesium digestibility. In horses, studies found no significant differences in calcium retention between low magnesium and high magnesium diets, and no effect of oxalates on magnesium uptake. In the horse, calcium is absorbed in the small intestine, whereas the



large intestine was the major site of phosphorus absorption. This is contrary to ruminants and swine where the small intestine is the primary site of phosphorus absorption. It is obvious from several equine studies that magnesium uptake is different to calcium uptake in horses.

Also in contrast to other species, vitamin D does not appear to play a key role in regulating calcium and phosphorus balance in horses. Vitamin D toxicity, a life-threatening disease of horses and other domestic animals, causes weight loss, poor appetite, lameness, painful stiffness and reluctance to move. Mineral deposition in the kidneys leads to renal failure, polyuria, and polydipsia. Sudden death from cardiovascular mineralization has been reported from overdosing vitamin D.

Various herbal supplements are used in the equine industry. The safety of many is unknown and caution must be taken. There are also potential conflicts with medication and racing rules. Some herbs have drug-like actions and can interact with dietary components. Others may contain prohibited substances like salicylates, digitalis, heroin, cocaine and marijuana. Cross-reactions and contraindications are known to occur between certain medicinal therapies and herbal preparations. In horses prescribed any medication, your veterinarian should be informed of the concurrent administration of any herbal preparation.



More research is needed before we understand safety and efficacy of garlic preparations. Studies in horses found that freeze dried garlic fed at >0.4 g/kg bodyweight per day resulted in anaemia. Other symptoms of garlic toxicity include gastric irritation, increased bleeding time and reduced sperm production. Even though ginger has been theorized in horses and proven in humans to cause gastric ulcers, many ulcer relief supplements for horses contain ginger. Some herbs contain prohibited substances like salicylates, for example meadowsweet, poplar, willow and wintergreen; heroin in poppies; caffeine in cocoa, coffee and tea and steroids in ginseng, licorice, hops and sage. Prolonged use of echinacea can damage the liver.

There are no reliable, one size fits all when it comes to supplements. Where specific nutritional supplementation is needed (e.g. oxalate pastures; clinical or subclinical signs suggestive of imbalance or deficiency; selenium deficient areas), nutritional supplements for specific deficiencies should be selected, rather than relying on a complete product. It is important to have a clear understanding of the supplements fed and what they are supposed to achieve. Extrapolating between species can cause problems. Peculiarities in ruminants such as interactions between magnesium and potassium or between copper and sulfate do not play a role in monogastric species. For instance, hem-iron is not an ingredient of a typical equine diet; acidification of the

stomach content and the pH of the gastrointestinal tract have a strong impact on mineral solubility; transport systems through the intestinal wall are not the same – in horses there is a vitamin D-independent calcium absorption. Analogies from humans and other animals should be interpreted with extreme caution in the horse.

Finally, although the signs of acute and severe intoxication may be clinically obvious – there are many levels of oversupplementation each causing some degree of damage which may not always be visible. Effects of mild oversupplementation can be vague (poor performance, reduced growth, increased risk of other diseases) and difficult to diagnose. And diagnosis may depend on blood, hair, stomach contents, feed analysis and liver, kidney or bone biopsy. Best just to take care and 'not go there'.



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 Dr Jen Stewart has been an equine veterinarian for more than 40 years & an equine nutritionist for more than 10 years. Jen has been developing premium formulas for studs, trainers & feed companies in Australia & around the world & regularly consults to leading international studs & trainers in various countries. Jen has spent a fair bit of time researching & being involved in nutritional management of developmental orthopedic diseases, colic, tying-up, laminitis, performance problems, post-surgery & other conditions. And is currently the only practicing equine veterinarian & clinical nutritionist in Australia.

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