VITALIS

Feed supplement for cats and dogs with minerals and vitamins

VITALIS <VI-TA-LIS
The name is inspired by the Latin word « vītālis », which means « of or belonging to life, vital »
Andrews EA, Freund W, Lewis CT, Short C. A Latin dictionary. Oxford: Clarendon Press; 1879.

Vitalis is formulated to support vitamin and mineral deficiencies in cats and dogs, based on veterinarian's recommendation. More often nutritional deficiencies are the direct result of an inadequate supply of the required factor. Prolonged anorexia, inadequate feeding or feeding with low quality or imbalanced diets deprive animals of vitamins and minerals. As an example, cobalamin deficiency can be associated with long-term feeding of vegetarian diets, since it is exclusively made by microbes and found in animal tissue. To a lesser extent, nutritional deficiencies can be secondary to other conditions which interfere with the proper assimilation and utilization of nutritive factors, i.e., iron deficiency due to chronic blood loss or cobalamin deficiency commonly associated with chronic enteropathies in dogs.

Iron

Iron is essential to virtually all living organisms and is integral to multiple metabolic functions. Iron in the form of heme is vital to many metabolic functions, most importantly oxygen transportation in hemoglobin[1]. Iron is also a component of multiple enzymes, including cytochromes, necessary for energy generation and drug metabolism. Through the donation or acceptance of an electron, iron exists in either a reduced ferrous (Fe^{2+}) or an oxidative ferric (Fe^{3+}) state.

In non-critical conditions, oral iron therapy is usually preferred over parenteral iron administration in small animals due to its low cost and higher safety[2]. Both ferrous and ferric forms are available but only the ferrous form is recommended due to superior absorption. Ferrous sulfate is used most frequently but ferrous gluconate and fumarate can also be used.

Copper

Copper is a component of several enzymes (oxidases), and a catalyst in hemoglobin formation. In most species, copper can be absorbed in all segments of the GI tract; however, the small intestine is the major site of absorption. Dietary copper deficiency has been reported to occur in dogs and cats and thus is of practical concern[3]. Supplemental Cu is generally added to cat and dog foods as either copper oxide or copper sulfate ($CuSO_4 \cdot 5H_2O$).

Zinc

Zinc is a constituent or activator of more than 200 enzymes, so it is involved in a number of diverse physiologic functions. Indeed, an adequate zinc status is required for the proper function of several systems. In dogs, the role of zinc in skin health has been well documented and clinical reports show that impairment of zinc status might be associated with disorders in other systems[4].

Zinc absorption occurs primarily in the duodenum, jejunum and ileum. Only small amounts are absorbed from the stomach. Its availability is decreased by a number of factors (phytate, high dietary levels of calcium, phosphate, copper, iron, cadmium and chromium). Zinc chelate of amino acids hydrate is recognized as an efficacious source of zinc in meeting animal requirements.

Calcium and Phosphorus

Calcium and phosphorus are stored mostly in skeletal tissue, although they are present throughout the body[5]. Bone metabolism and calcium and phosphorus absorption and retention are influenced by vitamin D as well as the relative dietary concentrations of these and other minerals. Because the bone is the major reservoir of calcium and phosphorus, its metabolism is impacted by their relative homeostasis. Vitamin D plays a key role in bone remodeling and bone growth by activating osteoblasts and osteoclasts.

B1 (thiamin), B5 (pantothenic acid) and B6 (pyridoxine)

These are vitamins directed at specific features of carbohydrate, protein, or lipid metabolism. Thiamin pyrophosphate (TPP) is the major co-enzymatic form of B1 (thiamin) and is required for only a small number of enzymatic reactions. B5 (pantothenic acid) occurs mainly in bound form, (i.e., coenzyme A [CoA] and acyl-carrier protein). CoA is found in all tissues and is notable for its role in the synthesis and oxidation of fatty acids, and the oxidation of pyruvate in the citric acid cycle. B6 (pyridoxine) is involved in most of the reactions of the amino acid metabolism and with the synthesis of the heme precursor porphyrin.

A number of factors (e.g., canning of pet food) influence thiamin availability and may induce a deficiency. On the other hand, pantothenic acid deficiencies are extremely rare, because of its widespread occurrence in foods. Animals' requirement of vitamin B6 is positively related to their intake of protein and amino acids and deficiency is rarely seen, as most diets provide adequate amounts[6,7].

B2 (riboflavin)

Riboflavin is the precursor to flavins, coenzymes in about 50 enzymes in mammals, which participate in intermediary energy metabolism and function mainly in oxidoreductase types of reactions. Most riboflavin found in food sources is in a form

not readily absorbed and needs to be hydrolyzed before it is absorbed in the upper GI tract. Commercial pet foods are usually supplemented with synthetic riboflavin[6,7].

B3 (niacin)

Normally, niacin is derived from food by hydrolysis of NAD (nicotinamide adenosyl dinucleotide) and NADP (nicotinamide adenosyl phosphodinucleotide) to niacin. Niacin may also be synthesized from tryptophan. As most animals consume diets that contain adequate tryptophan and available NAD and NADP, niacin deficiency is usually not a problem. An exception to this generalization is cats, in which the degradation of tryptophan does not proceed along a pathway that leads to nicotinic acid. For cats, available niacin is an obligatory dietary factor.

Niacin in foods is found mainly as NAD and NADP, which may be free or bound to other macromolecules. After ingestion, NAD and NADP undergo hydrolysis by the intestinal mucosa to release free nicotinamide, which is readily absorbed. Dietary niacin (nicotinamide) is absorbed readily through the gastric and small intestinal mucosa[6,7].

B12 (cobalamin) and folic acid

These are vitamins involved in single-carbon metabolism. Folic acid functions as a one-carbon donor and acceptor molecule in nucleotide biosynthesis, phospholipid synthesis, amino acid metabolism, neurotransmitter production and creatinine formation. Cobalamin is a cofactor for metabolic processes like nucleic acid synthesis, amino acid synthesis, and the citric acid cycle. Cobalamin is closely paired with folate in the production of methionine from homocysteine.

Mammals are unable to synthesize cobalamin and therefore rely on adequate food intake. Cobalamin absorption is a complex process in the stomach, duodenum, and ileum, requiring a functional exocrine pancreas. Thus, a great number of gastrointestinal diseases like chronic enteropathies, intestinal lymphoma, or exocrine pancreatic insufficiency can lead to hypocobalaminemia[8]. Folate is found in several foods, but is unstable in a variety of conditions. Commercial pet foods are supplemented with folate to overcome the effects of processing and storage.

Vitamin A

Vitamin A is essential for a number of distinct biologic functions. It is necessary for normal vision, growth, reproduction, immune function and maintenance of healthy epithelial tissue. Vitamin A is also involved in the expression and regulation of many genes.

Naturally rich sources of vitamin A include fish oil, liver, egg and dairy products. Vitamin A deficiency is rarely observed in dogs and cats because commercial pet foods contain adequate amounts and because dogs are able to convert the

carotenoids found in plant matter into active vitamin A. The cat differs from the dog because it cannot use carotenoids and must consume all of its vitamin A as preformed retinyl palmitate or free retinol from animal tissues. The most common vitamin A supplements used in pet foods include vitamin A esters (all trans retinyl palmitate, acetate or propionate) or vitamin A provided as fish oils. Because of stability issues, vitamin A sources are often coated, beaded, prilled or spray dried with antioxidants and emulsifying agents[6,7].

Vitamin D

Two important forms of vitamin D are cholecalciferol (vitamin D3), which occurs in animals and ergocalciferol (vitamin D2), which occurs predominantly in plants. The primary function of vitamin D is to enhance intestinal absorption and mobilization, as well as retention and bone deposition of calcium and phosphorus[5].

The skin of most mammals can produce cholecalciferol from the provitamin 7-dehydrocholesterol via activation with ultraviolet-B light. However, this pathway is inefficient in dogs and cats because of the higher activity of the enzyme 7-dehydrocholesterol- Δ7 reductase that converts 7-dehydrocholesterol to cholesterol. Therefore, dogs and cats need dietary vitamin D. With the exception of animal products, most natural foods contain low vitamin D activity. Fish, in particular saltwater fish such as sardines, salmon, and herring, and fish liver oils contain significant to large quantities of vitamin D[6,7].

Vitamin E

Vitamin E is a term for a group of compounds with the biologic activity of α-tocopherol. Vitamin E functions as a biological, chain-breaking antioxidant that neutralizes free radicals and prevents the peroxidation of lipids within cellular membranes. In commercial pet foods, vitamin E also protects unsaturated dietary fats from destructive oxidation, as the vitamin is preferentially oxidized before the unsaturated fatty acids, thus protecting them from rancidity. Increasing the level of unsaturated fat in the diet increases an animal's vitamin E requirement.

Only plants synthesize vitamin E, and the richest sources of vitamin E are vegetable oils. Animal tissues tend to be low in vitamin E, with the highest levels occurring in fatty tissues. The addition of large amounts of fish products to a cat's diet appears to be the most common cause of low levels of vitamin Common vitamin E supplements used in pet foods include α-tocopherol and α-tocopherol acetate[6,7].

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