

FOR VETERINARIANS & PET PROFESSIONALS WORLDWIDE

Water Soluble Vitamins-Vitamin C, Biotin and Vitamin B Complex

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According to Stedman's Medical Dictionary, a vitamin is "one of a group of organic substances, present in minute amounts in natural foodstuffs, that are essential to normal metabolism." As defined, vitamins are present in very small quantities in most foods and it is this fact that leads to the manufacture of vitamin supplements for dogs and cats and people. Not only are vitamins naturally present in only small amounts, they are also essential for life.

The importance of vitamins has been known for only a short time, however their actual effects were demonstrated long ago. Around 400 B.C., the father of modern medicine, Hippocrates, first advocated using liver to cure night blindness. We now know that the essential component of the liver was vitamin A and it was the lack of vitamin A that caused the night blindness. Beriberi, the once feared paralytic disease of humans, was found to be curable by feeding unpolished rice. It is now known that the unpolished rice was rich in the vitamin B1-thiamine. Low thiamine levels were the real cause of beriberi and a simple diet change could cure the paralysis. The primary vitamins are normally identified as vitamin A, D, E, K, C and B complex. Of these A, D, E and K are the fat soluble vitamins. Vitamin C and B complex are water-soluble. The fat-soluble vitamins are commonly stored in special fat storage cells called lipocytes, whereas the water-soluble vitamins are not stored within the body except in small amounts. It is for this reason that the fat-soluble vitamins pose the biggest threat if oversupplemented. They are stored and build up within the body.

The body tissues do not readily store water-soluble vitamins and when fed in excess, they are easily eliminated from the body via the urine. Because they do not accumulate within the tissues, there is minimal risk of toxic effects. In fact, we are not aware of a single toxicity case ever having been documented in either dogs or cats. All of the water-soluble vitamins, just as the fat-soluble

ones, are inherently important for life. The lack of adequate amounts of vitamins has been well described in both pets and people.

We will outline the water-soluble vitamins: vitamin C and B complex. Of the vitamin B complex we will discuss thiamin, niacin, riboflavin, pantothenic acid, pyridoxine, folic acid, B12 and biotin.

Vitamin C

Vitamin C has long been considered the cure for the common cold in humans. In pets, it has been thought

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PRO PAC® display stand at the Pro Pet Trade Show in Brno, Czech Republic, June, 2001. Velkoobchod Salac, PRO PAC® Distributor in Czech Republic.

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Vitamin E, the “Anti-Rust” Vitamin

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When metals are exposed to air and moisture they rust. The oxygen from this exposure causes them to oxidize. If foods are exposed to oxygen as well, they go rancid. When this happens to living tissues we witness aging, disease, inflammation and cancer. In other words this process not only occurs to metals and foods but also to the tissues within living bodies. To prevent foods and tissues from oxidizing, nature has provided the antioxidants. Antioxidants prevent oxidation or the “rusting” of foods and living tissues.

Vitamin E is one of nature’s powerful antioxidants. Vitamin E or alpha tocopherol, is a fat and oil soluble vitamin belonging to the group of compounds the tocopherols that can prevent oxidation. What is an antioxidant? First we must discuss oxidation which simply is combining with oxygen. The rusting of metal and the brown spoilage of fruit or butter going rancid are examples of oxidation combining with oxygen, spoilage in other words - nature’s natural recycling process by decomposing materials to their basic elements.

Modern medicine is now saying that perhaps some of our modern diseases are due to oxidation - we’re slowing rusting out. An antioxidant is a compound that prevents oxidation.

Oxygen is essential for basic cell functions in dogs, cats, humans and most animals, as we all know. However, oxygen can also produce toxic substances and these highly reactive substances, called “free radicals” can combine with other molecules in the body, such as heavy metals or other foreign chemicals resulting in internal cellular destruction. These free radicals are unstable compounds with an unpaired or extra electron in their chemical makeup looking for an electron to become stable. The antioxidant offers this electron that the free radical is looking for, rendering it stable, preventing it from becoming destructive to living cells. Drs. Stephen Davies and Alan Stewart in their book *Nutritional Medicine*, Avon Books, state “It is now becoming evident that free rad-

ical reactions in mammalian systems are probably responsible for such diverse physiological processes as inflammation, aging, drug induced damage, degenerative arthritis, alterations in immunity, cancer and cardiovascular disease.”

Antioxidants such as vitamin E counter this process. These substances protect the cells against the oxidation process. Some of the other common antioxidants that we know are vitamin A, vitamin C, selenium, some herbs and several enzymes found within the living body. These substances plus others that are being discovered can, for example, prevent fruit from spoiling or fats from going rancid. More important, however, is the protection that these antioxidants provide inside the body.

Unsaturated fatty acids in foods and the lipid (fat) membranes of body cells are very vulnerable to oxidative damage. Antioxidants such as vitamin E interrupts the oxidation of these membranes by giving electrons to the free radicals before they can cause damage.

A recent study done at Colorado State University shows when 80 beef steers were supplemented with 500 units of vitamin E per day for 123 days, it had a remarkable effect on meat shelf life. For example, the number of T bone steaks that had to be “marked down” for immediate sale was reduced by 83%. In other words, the meat from the steers fed vitamin E was prevented from spoiling as quickly as meat from steers that were not supplemented with vitamin E. More studies are on going.

I believe that this demonstrates the effects of vitamin E as a potent antioxidant within the animal’s bodies. Is this also happening within our bodies and the bodies of our pet animals when they eat

foods containing antioxidants such as vitamin E. Is the rusting out process slowed down?

Manufacturers of dry pet foods add antioxidants to their pet foods to extend shelf life and prevent spoilage. Synthetic antioxidants such as ethoxyquin, BHA and BHT are being used to prevent the fat in pet foods from going rancid in storage and on exposure to air and moisture when the bags are opened.

Controversy has arisen over the years with regard to what these synthetic fat preservatives are doing to the animals that eat them over an extended period of time, in other words, what are the long term effects of the synthetic antioxidants on the fat cells within the body of the cat or dog? Some pet food manufacturers are now using antioxidants such as vitamin E (alpha tocopherol) and vitamin C (ascorbic acid and/or sodium ascorbate) to preserve the fats in their dry pet foods and are calling these products “Natural Cat or Dog Food”.

If we raise the question, why are we seeing an increase in chronic diseases especially those associated with the immune system? The answer may lie with excessive oxidation and free radicals. Excessive oxidation or oxidative stress can develop from many sources. Nutritional deficiencies, disease, drugs, stress and heavy metal pollutants from our pet’s environment or the environment of the food sources can increase the amounts of free radicals in the pet’s body.

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PRO PAC® as the official sponsor at an international dog competition in Quito, Ecuador, August 2001.

Water Soluble Vitamins *(continued from page 1)*

to prevent hip dysplasia, cure feline leukemia, and prevent urinary tract infections. We doubt that its use will prevent a dog that genetically carries the trait of hip dysplasia from developing this condition. However, we have worked with several animals that had clinical hip dysplasia, that were given high levels of vitamin C, seemed to exhibit fewer signs of joint pain. It did not cure the condition but it did seem to allow the patient to better live with the problem.

In the case of bladder infections, as in human medicine, we believe that vitamin C is unusual in that it is excreted unchanged totally via the kidneys, and it therefore acidifies the urine. This makes the bladder a much less hospitable place for bacteria to live. Most of the bacteria that cause cystitis (bladder infection) survive much better in environments that have an alkaline pH. Therefore, by acidifying the urine with vitamin C, these organisms are often eliminated. This is the reason many women are told to drink large quantities of cranberry juice by their doctors when they have cystitis.

As far as its use in viral diseases like the common cold or feline leukemia, in all honesty, there is little evidence of its value. At the same time we would readily admit that vitamin C can do no harm when used. As we stated, it is excreted unchanged via the urine.

Forms of Vitamin C: We know that vitamin C exists in two forms: as dehydroascorbic acid and as ascorbic acid. Ascorbic acid is easily hydrolyzed (mixed with water) and therefore it is readily absorbed through the intestinal wall.

Likewise, it easily enters the urine to exit the body. Very little is stored within the body and the minute amount that is, is contained within the adrenal gland. Ascorbic acid can be fed or it can be manufactured within the body from glucose. Unlike dogs and cats, guinea pigs and humans cannot manufacture vitamin C so their only source is in their diet.

Therapeutic Uses: Ascorbic acid plays many important functions in bone

formation. It is involved in bone growth as well as bone mineralization. Deficiencies of ascorbic acid result in the syndrome known as scurvy. Dogs with scurvy exhibit weak bones and swollen joints usually accompanied by severe tissue hemorrhaging. Scurvy has not been reported in cats. In young dogs, scurvy is sometimes referred to as hypertrophic osteodystrophy (HOD). Dogs with HOD generally exhibit swollen, painful joints especially of the limbs. The swollen areas are the portions of the long bones that are growing. We might add here that a lack of vitamin C is only one factor in HOD. There are other causes of HOD that are unrelated to a vitamin C deficiency. A puppy may have HOD, but have perfectly adequate amounts of vitamin C. With this in mind, it is easily explained that only some patients with HOD will respond to vitamin C therapy. Vitamin C is definitely justified as a supplement, especially in fast-growing puppies and in lactating bitches. It is not, however, a cure of hip dysplasia. Hip dysplasia is a genetic conformational abnormality and vitamin C cannot alter genetics. It may help alleviate the pain associated with dysplastic hips, but hip dysplasia is genetic and not nutritional. Whether the dog is in pain or not, or whether vitamin C does or doesn't help, the dog is still dysplastic and should be treated as such.

Vitamin C has been used with varying degrees of success in helping prevent the formation of some bladder stones in dogs and cats. The vitamin C makes the urine more acidic and maintaining an acid urine helps discourage the creation of most stone types.

In conclusion, vitamin C is widely used as a supplement in growing, pregnant, lactating, stressed, and working pets. There are numerous Vitamin C supplements available. There is no concern for Vitamin C toxicity.

Vitamin B complex

Vitamin B complex consists of a multitude of B vitamins. We will detail thi-

In pets, Vitamin C has been thought to prevent hip dysplasia, cure feline leukemia, and prevent urinary tract infections.

amin, niacin, riboflavin, pantothenic acid, pyridoxine, folic acid, B12, and biotin. All are B vitamins and together form the water-soluble vitamin B complex. Toxicities from B vitamins generally pose no concern so we will mainly discuss their functions and the conditions that may result from deficiencies.

Thiamin: Thiamin, or vitamin B1, was the very first water-soluble vitamin to be identified. It is required for the normal function of muscles and nerves because it converts glucose to energy.

Thiamin is found in plants, vegetables, fruits, milk, fish and other meats. Like all water-soluble vitamins, it is not stored within the body so it is extremely important that the diet have a sufficiently high amount.

In veterinary medicine, a thiamin deficiency is generally associated with pets that are fed a large amount of raw fish. Herring, smelt, and catfish contain large amounts of thiaminase, an enzyme that destroys thiamin. Pets fed these raw meats as a sole source of food with become thiamin deficient. Cooking fish prior to feeding will destroy the thiaminase enzyme and therefore cooked fish poses no problem. A deficiency of thiamin results in loss of appetite, weakness, loss of reflexes, loss of nerve control, and eventually death.

Niacin: Niacin, another B vitamin, plays a role mainly in helping enzymes to function properly. Niacin is found in adequate levels in meats and meat by-products and is very low in vegetables and grains. "Black tongue" and "sore mouth disease" are the terms used to describe a dog or cat suffering from a niacin deficiency. A pet suffering with black tongue will lose weight, fail to eat, and have red inflamed gums, lips, and inner cheeks. Bloody diarrhea and death may follow. Niacin deficiency is generally encoun-

Vitamins A, D, E and K are the fat soluble vitamins. Vitamins C and B complex are water-soluble.

Water Soluble Vitamins *(cont'd from page 3)*

tered when owners formulate their own diets for their pets and do not include meat as part of the ration. Be very careful when trying to convert a pet into a vegetarian. Dogs are omnivores, which means they must eat meats and vegetables. Cats are carnivores which means they must eat meat.

Riboflavin: Riboflavin, also known as vitamin B2, has been proven to be essential to normal growth, muscle development, and hair coat. Riboflavin is found naturally in organ meats and dairy products. It is lowest in grains, vegetables, and fruits. The unsupplemented vegetarian pet is at extreme risk of developing a riboflavin deficiency. Dogs fed a diet deficient in vitamin B2 will have poor growth, eye abnormalities, weakness in rear limbs, and eventually heart failure. Deficient patients usually have periodic episodes of fainting, and this is termed the "collapsing syndrome of dogs." Riboflavin toxicity is rare if not nonexistent; we know of no documented cases.

Pantothenic acid: Pantothenic acid is another B vitamin and is found in sufficient quantities in most raw food-stuffs including meats and vegetables. Processing of foods will reduce the amount of pantothenic acid available to the dog or cat. The role of pantothenic acid has been well described. This acid enables the body to create usable energy from carbohydrates, fats, and proteins. The symptoms of pantothenic acid deficiency include loss of hair, diarrhea, and gastric (stomach) upsets. It has also been associated with abnormal graying, particularly in black-coated animals. There are no known toxicities.

Pyridoxine: Pyridoxine, also known as vitamin B6, is another B complex vitamin. Vitamin B6 is found in many foods, but processing easily destroys it. B6 is used by the body in the utilization of amino acids. It is absolutely essential for life. Deficiencies of pyridoxine lead to anemia, poor growth, kidney stones, tooth cavities, skin lesions, and in advanced cases, death. There are no known toxicities.

Folic acid and vitamin B12: Folic acid and vitamin B12 (also called cyanocobalamin or cobalamin) are two closely related B complex vitamins and

are usually discussed together. They are necessary for the bone marrow to produce red blood cells, and a deficiency of either can lead to advanced anemia. In this type of anemia the red cells are fewer in number but are larger than normal (macrocytic). The quality of white blood cells may also be reduced. Both vitamins are usually included in the diet and are found in organ meats. Toxicities are of no concern.

Biotin: Biotin is the last of the B complex vitamins that we will detail. Biotin is one of the most discussed of all vitamins, primarily because of its role in maintaining healthy skin and hair. It does much more than this, as it is necessary for growth, digestion, and muscle function. In some animals, it has been linked to litter size.

Riboflavin, also known as vitamin B2, has been proven to be essential to normal growth, muscle development and hair coat.

Biotin deficiencies have been reported following the ingestion of raw egg whites. Raw egg whites contain an enzyme called avidin that acts to destroy biotin. It is best if raw egg whites are not fed to dogs or cats. Cooking inactivates avidin. The yolk is very high in Biotin and if the whole egg is fed, the avidin in the white and high biotin in the yolk cancel each other out. A patient suffering from a lack of biotin may have poor hair, skin lesions, dried eye discharge, diarrhea, decreased letter size, and in advanced cases, a paralysis of the limbs. Biotin is found in grains, but is not always of a usable quantity. Diets rich in corn or soybeans are best, while those of wheat and barley are deficient. Beef liver supplies the richest source, with brewers yeast being next highest. Biotin supplements are also available. Biotin toxicity is rare to nonexistent.

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Vitamin E *(cont'd from page 2)*

Combined with a diet of refined or processed foods which have removed many of nature's known and unknown antioxidants that would normally offer protection. This then may be the answer to why we are seeing more diseases such as cancer, allergies and hereditary problems in our pet populations today.

Environmental poisons such as insecticides, herbicides, preservatives, taste enhancers and color additives as well as polluted air and water are increasing the load of destructive free radicals that our dog's and cat's bodies must deal with.

To help our animals deal with this, the argument can become quite convincing for feeding fresh foods and supplementing with vitamins and minerals. The particular substances that we know that offer antioxidant protection for the cells are vitamins A, C and E, selenium, zinc, manganese and copper.

Vitamin E combined with its helper selenium are two such antioxidants. Vitamin E is a fat and oil soluble vitamin made by nature in a variety of plants. Food sources that are rich in tocopherols include wheat germ and the oil of corn, cottonseed, soybean and sunflower. Most animal sources have limited amounts of vitamin E however the vitamin is present in egg yolks and liver.

Antioxidants are getting a lot of press lately with regard to their health benefits as well as new sources being discovered and researched. For example, plants such as garlic and sprouts, the herbs thyme, ginkgo, milk thistle and pycnogenol from pine bark contain antioxidants. We are going to hear more in the future about antioxidants and how free radicals cause disease.

Vitamin E, as an antioxidant, is being utilized more and more in our everyday lives. It is being used as a supplement to prevent the destructive intentions of free radicals and as a preservative for foods by extending shelf life both by adding it to the food or by feeding it to meat producing animals. The "anti-rust" vitamin is becoming quite popular.

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