

# The ABCs of Vitamin A

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## The many hats of Vitamin A

“Vitamin A” refers to a large family of fat-soluble retinoids, primarily retinol and retinyl esters. Retinol is one of the most active forms of Vitamin A and is found only in animal sources, including liver and egg yolk, as well as in fortified products. It is often called “preformed Vitamin A.”

Precursor-Vitamin A occurs in plants in the form of carotenoids. They are essential pigments in photosynthesis, and also act as photo-protectors, antioxidants, color attractants for pollinators, and precursors of plant hormones in non-photosynthetic organs of plants. Some carotenoids, but not all (there are over 600), serve as precursors for making the active form of Vitamin A in animals.

Vitamin A plays an important role in many bodily functions, including vision, bone growth, reproduction, and protecting epithelium and mucus integrity in the body. Epithelial cells line the internal and external surfaces of the body, including major body cavities, organs, ducts, and glands. Every vertebrate animal needs a source of Vitamin A in their diet.

Vitamin A also helps to regulate the immune system. There is evidence that this vitamin may help lymphocytes—a type of white blood cell that fights infections—function more effectively.

Vitamin A deficiency is believed to be the most common vitamin deficiency seen in turtles (rare in tortoises), and both Vitamin A deficiency and toxicity are *life-threatening* and *preventable*.

## You are what you eat

Vitamin A deficiency can have a number of causes:

The diet has an inadequate amount of preformed Vit A (or precursor Vitamin A in the case of tortoises. Frye (1999, *Reptile Care: An Atlas of Diseases and Treatments*, Neptune City, New Jersey: T.F.H. Pub.) suggests that the yolk remaining at the time of hatching in many reptiles, including chelonians, usually furnishes requirements for around six months, and that deficiency can suddenly appear after this point when stores will have become depleted.

- The animal fails to consume an adequate amount of a well-balanced diet; it looks good on paper but the animal is not eating enough of it.

- There is an excess of other fat-soluble vitamins in the diet competing with preformed Vitamin A (which is also fat-soluble) for absorption. For example, if there is too much Vitamin D3 in the diet, the animal may absorb too little Vitamin A and become Vitamin A-deficient.
- There is too little or too much dietary fat or protein in the diet that hinders absorption of Vitamin A.
- There is some condition causing malabsorption of nutrients in the small intestines (e.g., parasites) hindering adequate Vitamin A absorption.
- There has been deterioration of vitamins in the feed due to inappropriate storage (e.g., exposure to light, oxygen, high humidity, high temperature) or prolonged storage.

Vitamin A deficiency is common in young aquatic and semi-aquatic turtles and in box turtles that may be initially eating well but are fed diets of un-supplemented greens, muscle meat and poorly formulated commercial diets.<sup>2</sup>

Vitamin A deficiency is rarely seen in tortoises, but can occur when an animal has been anorexic for an extended (months) period, or when adequate foraging is prevented and the diet is restricted to foods low in  $\beta$ -carotene and perhaps other carotenoids — plant precursor to Vitamin A that tortoises are believed to efficiently convert to Vitamin A.

Excessive intake of Vitamin A is also a concern. This could occur due to:

- excess intake of foods or supplements high in preformed Vitamin A, such as liver
- excess intake of supplements containing precursor-Vitamin A (hypervitaminosis A has not been documented as occurring from eating foods naturally high in precursors)
- injection of preformed Vitamin A (the most common route of Vitamin A toxicity)

## **Symptoms of Vitamin A deficiency**

Vitamin A deficiency results in changes to epithelial cells that are widely distributed throughout the body. Epithelia cells in the respiratory, ocular (eye), endocrine, gastrointestinal and urogenital systems are the most often involved. Since so many systems can be affected, a variety of symptoms are possible with Vitamin A deficiency, although one should be aware that the same symptoms may have other etiologies.<sup>2,4</sup>

- Difficulty breathing, with wheezing and open mouth breathing, both associated with lung damage and respiratory infections
- Mouth infection, possibly accompanied by excessive mucus in the oral cavity
- Runny nose, associated with airway damage and infection
- Cloudy eyes
- Blindness (this may be permanent or temporary depending on the severity of the deficiency)
- Eyelid swelling and inflammation; eyes may appear sealed shut with or without solid whitish yellow cellular debris underneath the eyelids; may also be thick white discharge

- Swelling of the tympanum (usually aural abscesses do not appear to be associated with Vitamin A deficiency but it is possible)
- Thin and reddened skin
- Irregularly thickened skin that often cracks, and abnormal keratin growth in the seams between scutes in chronic cases
- Skin sloughing/blistering
- Lack of appetite
- Weight loss
- Dystocia (egg retention)
- Lethargy and depression
- Swelling of the limbs and groin (may be associated with fluid accumulation caused by kidney damage)
- Higher than normal incidence of infections of all sorts due to impaired immune function
- Star-gazing (turtle moves in a circle with head thrown back over head)

Again, the above findings may be the result of a Vitamin A deficiency but there could be other causes. Consult with your veterinarian!



This captive juvenile *Terrapene ornata* had a long history of dietary deficiencies. He entered rehab with a thick cap of purulent debris underneath the eyelids. Shown here is the cap from the left eye (inset photo). The cap over the right eye had already been removed. Both eyes appeared to be normal with no obvious loss of vision.

## Diagnosis

Microscopic examination of tissue biopsies and Vitamin A assay of the liver or blood can be helpful in a veterinarian's diagnosing a Vitamin A deficiency, but they are expensive and take time to get results.

It can be enormously helpful for your vet to get a full history on your pet, including the following:

- **Dietary history:** Describe how often you feed your pet, and exactly what and how much of each food item is eaten, not just what is offered. It may help to bring a picture of a prepared diet since the way in which food is prepared and presented can affect consumption (e.g., very finely diced and mixed up versus grossly cut up and served as separate food items)
- **Social Setting:** What is the species, age, and gender of any animals co-habiting with your pet. Is it possible that a pen-mate or other animals – insects, mice, rats, birds – is eating the patient's diet?
- **Housing:** Bring pictures of the habitat plus these descriptors: habitat size and location, sun exposure (if outdoors), bedding type and moisture profile (e.g., dry all over, moist all over, a mosaic of moisture levels), lighting used and light cycle; daytime and nighttime humidity and temperature profile
- **Cleaning Protocol:** How often is the habitat spot cleaned, deep cleaned, water changed, type of filtration system used and protocol for cleaning it (in aquatic habitats), products used in cleaning
- Storage protocol for any commercial diet used: (See p.5)

Excessive intake of Vitamin A is also a concern for turtles and tortoises. Dr. Abbot remarked that this could occur from:

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- injection of preformed Vitamin A (the most common route of Vitamin A toxicity)

## Treatment—proceed with caution!

Treatment should only be done under veterinary supervision. It may include oral or injectable preparations of Vitamin A (*very rarely if ever recommended for tortoises*), along with treatment for any illness that is linked to the deficiency (e.g., respiratory or eye infection, parasite infestation). It is difficult *although certainly not impossible* to induce hypervitaminosis A (Vit A toxicity) with oral preparations, since gut absorption and liver metabolism provide natural controls. However, injectable preparations can easily induce a fatal hypervitaminosis if the animal is not actually suffering from a Vitamin A deficiency or the amount administered is too high.

Vitamin A toxicity may manifest as swollen eyes, and dry flaky skin which can progress to blistering and sloughing of the top layer of skin, thus exposing the reddish, moist dermis (lower skin), and in some areas, underlying muscle.<sup>2,5</sup> Recovery can take months and require intensive care comparable to that provided serious burn victims. Prospects for recovery are not good in severe cases often due to secondary infections, fluid loss and organ failure.

Beware of over-the-counter claims: Pet stores commonly sell Vitamin A eye drops that claim to cure Vitamin A deficiencies and eye infections. These products are ineffective in resolving either of these conditions, and although they may cause no direct harm and may be beneficial in lubricating dry eyes, they can delay proper diagnosis and treatment.

## **Once again, you are what you eat**

Proper diet is essential as an adjunct to treating Vitamin A deficiency and is the ultimate solution to preventing its recurrence. There are many commercial chows sold for turtles and tortoises, most of which are highly suspect for meeting the dietary needs of the animals no matter what claims are made on the label nor how well your pet eats it. In the author's opinion, Mazuri offered the single best line of commercial chows sold. A diet plan for box turtles is provided at [www.boxturtlefacts.org](http://www.boxturtlefacts.org). It has been vet-reviewed and -approved where Mazuri Aquatic Turtle Diet is selected as the chow portion of the diet. It is advisable not to offer significantly more food at each meal than your pet will eat or present the meal with the various components separated out on the food dish. This can lead to selective eating of preferred items and potential vitamin deficiency or imbalance.

The current paper is focused on box turtles. For guidance on diets for semi-aquatic turtles, consult the links posted by the [Mid-Atlantic Turtle & Tortoise Society](#). For tortoises, here are a few excellent websites: [Tortoise Trust](#), [California Turtle & Tortoise Club](#), [Arizona Department of Game and Fish](#) (for Desert Tortoises), [Hermann Haven](#) (for Hermann's Tortoise), [Russian Tortoise](#) (diet only).

## **It counts how you store it!**

The nutritional content of food is not fixed, but you can minimize the rate of deterioration by following these simple guidelines:

- Store Vitamin A-fortified commercial diets in the refrigerator in an opaque, airtight container. Exposure to light, oxygen, high humidity, and high temperature (even room temperature) speed up the rate of deterioration.
- Since some deterioration of a feed product likely occurred prior to your obtaining it, replace the product six months after opening it or by the expiration date, whichever is sooner. Write the date opened on the container as a reminder.
- Store frozen whole vertebrate prey in resealable freezer bags (the bags they are sold in are not necessarily freezer-quality). Toss any uneaten ones after six months from purchase date, sooner if freezer burn is seen.