The ABCs of Vitamin A

by

Sandy Barnett, Herpetologist

sandybarnett95@gmail.com
www.boxturtlefacts.org

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A common diagnoses of sick chelonians includes "hypovitaminosis A," or vitamin A deficiency, especially when the animal has swollen eyelids. However, many of the symptoms of hypovitaminosis A are the same as those of other disorders, including "hypervitaminosis A," or the excessive accumulation of vitamin A in the body.

The many hats of vitamin A[1]

"Vitamin A" refers to a large family of fat-soluble vitamins. Retinol is one of the most active forms of vitamin A and is found in animal foods such as liver and eggs and some fortified products. Retinol is often called "preformed vitamin A." Some plants contain dark pigments called "provitamin A carotenoids" that can be converted to vitamin A in the body.

Vitamin A plays an important role in many bodily functions, including vision, bone growth, reproduction, cell division, and cell differentiation (the process by which a cell's function is determined). Vitamin A also plays a major role in the production and maintenance of healthy epithelial cells—the cells that line the internal and external surfaces of the body. If those linings break down, bacteria, fungi and viruses can enter and cause infection.

Vitamin A 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.

You are what you eat

Vitamin A deficiency occur in tortoises when foraging is prevented and the diet is restricted to foods low in β-carotene—a plant precursor to vitamin A—such as iceberg lettuce and cucumber, or when an animal has been anorexic for an extended (months) period.[2]

Vitamin A deficiency is common in young aquatic and semi-aquatic turtles and box turtles fed diets of unsupplemented greens (lettuce), meat and poorly formulated commercial diets[2]. Frye[3] 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.

Symptoms—more than you might expect

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 (in respective order) are the most often involved. Since so many systems can be affected, a variety of symptoms are possible with hypovitaminosis A. Among those commonly seen in chelonians are:[2, 4]

- 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
- Eye and eyelid swelling and inflammation; eyes may appear sealed shut with (in chronic case) or without (in early cases) solid whitish yellow cellular debris underneath the eyelids; may also be thick white discharge
- Swelling of the tympanum (due to middle ear infection)
- 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
- Egg retention (specially in box turtles)
- Lethargy and depression associated with various organ failures
- Swelling of the limbs and groin due to fluid accumulation (edema) caused by kidney failure
- Poor growth
- Higher than normal incidence of infections of all sorts due to impaired immune function.

Diagnosis—more difficult than meets the eye

Your veterinarian can use several factors to determine if your chelonian has a vitamin A deficiency, including:

- Dietary history
- Housing and hygiene protocol
- Clinical signs and elimination of other possible causes for each sign (e.g. swollen eyes caused by excessively low humidity, allergies, trauma or primary fungal, bacterial or nematode infections rather than hypovitaminosis A)
- Microscopic examination of tissue biopsies (expensive and often impractical)
- Vitamin A assay of the liver or blood (expensive, complex, not always possible on small specimens due to required sample size, values may be difficult to interpret)

Treatment—proceed with caution!

Treatment should only be done under veterinary supervision. It may include oral or injectable preparations of vitamin A, along with treatment for any illness that has occurred secondary to the deficiency (e.g., respiratory or eye infection). It is difficult although not impossible to induce hypervitaminosis A with oral preparations since gut absorption and liver metabolism provide natural controls. [4,5] 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.[2,5] If

your vet determines that your animal needs vitamin A injections insist that an oil-based preparation is used; water-soluble forms are more likely to result in toxicity.[5]

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 though they may cause no direct harm and may be beneficial in lubricating dry eyes, they can delay proper diagnosis and treatment. One popular product claims to be particularly useful with box turtle eye problems. In my experience, swollen eyes in box turtles are commonly due to keeping these animals in substrate that is too dry. Simply providing very moist mulch deep enough for the turtle to dig in and a large, easily accessible pool for soaking can often cause eye swelling to subside in a matter of days with no medical intervention. In aquatic turtles, swollen eyes are often primary infections associated with living in unsanitary water, assuming the diet is balanced. The solution here is better sanitation and treatment of the infected eye(s) with antibiotics prescribed by a veterinarian, but not Vitamin A therapy.

Once again, you are what you eat

Proper diet is essential as an adjunct to treating vitamin A deficiency (sometimes it is all that is required) and is the ultimate solution to preventing its recurrence. Tortoises and box turtles should be given diets that include foods rich in β-carotene such as dark leafy greens (e.g. dandelions, turnips, mustard greens, bok choy, collard greens), as well as yellow/orange colored fruits and vegetables (e.g. papaya, mangos, cantaloupe, squash, sweet potatoes, orange and yellow bell peppers, carrots). Of course diets must be tailored to each species and age class. A sulcata (*Geochelone sulcata*), for example, should have little fruit in its diet, whereas it is beneficial in the diet of a yellow-footed tortoise (*Geochelone denticulata*).

Aquatic and semi-aquatic turtles are unlikely to develop a vitamin A deficiency if fed a high quality commercial turtle chow (e.g. "Turtle Brittle" by Nasco, available online at www.enasco.com) along with dark leafy greens, earthworms, gutted-loaded insects, whole mice and fish dusted with a good multiple vitamin/mineral preparation.

Donoghue and Langenberg[7], Highfield[8, 9], Gurley[10] and McArthur[11] provide excellent advice on chelonian nutrition, as do the websites of the Tortoise Trust (www.tortoisetrust.org), Massachusetts Turtle Rescue (maturtlerescue.org; it includes many links to other sites) and the California Turtle and Tortoise Club (tortoise.org). Also review "Chelonian Links" on matts-turtles.org for recommended websites that discuss the care and diet of various species of turtles and tortoises.

Hypervitaminosis A—when the wrong treatment is given

If your vet mistakenly diagnoses your pet as vitamin A deficient when it isn't and treats with injectable vitamin A, it is possible for your chelonian to develop hypervitaminosis A. In turtles and tortoises, 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.[2, 5] Recovery can take months and require intensive care comparable to that provided serious burn victims. Systemic and topical antibiotic and antifungal preparations may be necessary. Also, fluid therapy and nutritional support may be required in severe cases, including surgical insertion of a feeding tub (pharyngostomy tube) in animals that cease eating and drinking. Prospects for recovery are not good in severe cases often due to secondary infections, fluid loss and organ failure.

References

1. National Institutes of Health, Office of Dietary Supplements, 2003, "Vitamin A and

Carotenoids," in Facts About Dietary Supplements, retrieved May 2005 from http://ods.od.nih.gov/factsheets/cc/vita.html.

2. McArthur, S., 2004,"Problem-solving approach to common diseases of terrestrial and semi-aquatic chelonians," in S. McArthur, R. Wilkinson and J. Meyer, *Medicine and Surgery of Tortoises and Turtles*, Oxford, UK: Blackwell Pub., pp 73-85.

4. Boyer, T., 1994, "Hypovitaminosis A and Hypervitaminosis A," in D. Mader, *Reptile Medicine and Surgery*, Philadelphia: W.B. Saunders Co., pp 382-385.

3. Frye, F., 1999, *Reptile Care: An Atlas of Diseases and Treatments*, Neptune City, New Jersey: T.F.H. Pub.,.

4.Wilkinson, R., 2004, "Formulary," in S. McArthur, R. Wilkinson and J. Meyer, *Medicine and Surgery of Tortoises and Turtles*, Oxford, UK: Blackwell Pub., pp 487–503.

5. Palmer, D.G., A. Rubel, F. Mettler and L. Voker, 1984, "Experimentally induced skin changes in tortoises by high parental doses of Vitamin A," *J. Veterinary Medicine Series A*, 31:625.

6. Donoghue, S. and Langenberg, J., 1996, in D. R. Mader (ed.), *Reptile Medicine and Surgery*, Philadelphia: W. B. Saunders Co., pp 148-174.

7. Highfield, A.C., 1996, *Practical Encyclopedia of Keeping and Breeding Tortoises and Freshwater Turtles*, London: Carapace Press.

8. Highfield, A.C., 2000, *The Tortoise & Turtle Feeding Manual*, London: Carapace Press.

9. Gurley, R., 2003, *Keeping and Breeding Freshwater Turtles*, Ada, OK: Living Art Pub.

10. McArthur, S. and Barrows, M., 2004, "Nutrition," in S. McArthur, R. Wilkinson and J. Meyer, *Medicine and Surgery of Tortoises and Turtles*, Oxford, UK: Blackwell Pub., pp 309-377.