

## How to Feed Reptiles Right

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Most reptile and amphibian (herps) diseases are nutritionally related therefore it is essential that veterinarians be a solid source of nutritional information for owners. Always evaluate dietary history of your herp patients; never assume the owner has good nutritional knowledge regardless of their experience. Nutritional diseases remain rampant in herps including nutritional secondary hyperparathyroidism, hepatic lipidosis, protein deficiency, foreign body ingestion, hypovitaminosis A, hypervitaminosis A, pyramidal shell growth, renal failure, starvation and obesity. Our goal is to prevent these diseases rather than treat them. To prevent disease veterinarians must be proactive with nutritional advice for their herp patients. Remember that water is the most important nutrient. Mammals can survive loss of most fat and glycogen reserves and half of their bodies' protein, but a 10–15% water loss is life threatening. Water is equally important to reptiles, and although they can withstand greater water loss, they still require water, even desert species. Some reptiles are not good at drinking from water bowls, examples include anoles, chameleons, day geckos, bearded dragons, eyelash vipers, green and ribbon snakes. These species need water misted, sprayed or dripped on them on a daily basis.

Ultraviolet (UV) light in the 290 to 320 nm wavelength (UV B) is critical to reptiles for activation of vitamin D<sub>3</sub>. UV light is not required in snakes and nocturnal geckos. UV light is almost entirely filtered by glass and plastics unless specifically UV transmissible. Intensity of UV light varies by 1/distance squared, so a light twice as far has one fourth the UV intensity. This means lights should be kept close, usually within 12–18 inches. Sunlight is an excellent source of UV light, especially in southern California. There are currently four major types of UV lights, fluorescent tubes, compact fluorescent bulbs, and mercury vapor spot or flood lamps. The author prefers the mercury vapor spot lights because they provide both heat and UV light, both important for activation of vitamin D. UV output of lights decreases well before visible output does, so they should be replaced every 6–12 months or when UV output drops below 70%. Not all reptile lights produce UVB, make sure you specifically check the light the owner is using online.

Another important fat soluble vitamin is vitamin A. Herbivores and some omnivores have an enzyme that converts vitamin A precursors, such as  $\beta$ -carotene, found in plants to active vitamin A (retinol). Most carnivores, insectivores and even some omnivores lack the enzyme to convert precursors to active vitamin A and are susceptible to vitamin A deficiency if no preformed vitamin A is in the diet. For these species, check the reptile multivitamin label, it must have vitamin A or retinol, retinal, retinyl ester, such as retinyl palmitate, not  $\beta$ -carotene. Almost half the reptile multivitamins on the market lack pre-formed vitamin A! Good quality reptile multivitamins should have a ratio of vitamins A:D<sub>3</sub>:E of 1000:100:10, many do not.

A persistent widespread veterinary misconception is that vitamin A injections help sick tortoises. Decades before mycoplasmosis was identified as the agent of upper respiratory tract disease it was thought hypovitaminosis A could be to blame and vitamin A injections were *de rigueur* in tortoises with runny nose syndrome. Tortoises, being herbivores, can convert  $\beta$ -carotene, or other vitamin A precursors, in vegetables, to retinol, so they rarely suffer from hypovitaminosis A. It is below the standard of care to give tortoises vitamin A injections, even once. With concentrated large animal vitamin A preparations available, it is exceedingly easy to induce hypervitaminosis A, with a single small dose. Iatrogenic hypervitaminosis A causes skin sloughing for months and makes existing disease worse. Box turtles and aquatic turtles, being more carnivorous, rely on preformed vitamin A in their diet, and are susceptible to hypovitaminosis A.

On a very simplistic level herp diets can be broken down to insectivores, carnivores, and herbivores or omnivores. Many reptiles have specialized dietary needs that require extensive appreciation of natural history. The following information serves as a foundation for most common species in captivity.

## **INSECTIVORES**

This group includes many lizards, amphibians and some turtles. Insects are deficient in calcium and most fat soluble vitamins and larval insects have high protein and fat content, if not starved. Feeding store bought crickets and mealworms without supplementation will cause calcium deficiency and may induce hepatic lipidosis. Calcium (Ca) to phosphorus (P) ratios of commonly fed insects are as follows; crickets 0.2 (0.07:2.6), mealworms 0.1 (0.08:1.2), wax worms 0.1 (0.11:0.9), and super mealworms 0.06 (0.03–0.12:0.7). Healthy Ca to P ratios for most vertebrates are generally considered one to two parts Ca for each part P, but can be higher for growing reptiles. As an example, consider salt-water crocodiles, *Crocodylus porosus*, the largest of all living reptiles. Juvenile salties eat insects, amphibians, crustaceans, small reptiles fish and rats, with an overall Ca:P ratio of 6.7 to 1, primarily because of crabs and shrimp which have calcium rich shells. Adult salties eat any animals they can get a hold of, especially mammals and fish, but less crabs and shrimp. The Ca to P ratio of their diet drops to 1.85 to 1. The take home message is that rapidly growing reptiles require much higher Ca:P ratios.

Improving the calcium content of feeder insects is simple, feed a calcium rich diet and dust insects with calcium. Originally feeding a calcium rich diet was called gut loading. Unfortunately, over time this has degraded into just feeding any cricket diet. Not all cricket diets are equal. One study showed three out of four commercial calcium fortified dry diets designed for crickets to be fed to reptiles contained no more calcium than unfortified diets. Despite claims on their labels, only one actually increased the calcium content of the crickets. Calcium fortified high moisture cricket waters or high moisture foods (cubes) are ineffective at increasing calcium content. Assume store bought insects are nutritionally inadequate at purchase. Rather than have owners search for a good cricket gut loading diet the author purchases one in bulk (Mazuri® Hi-Ca Cricket Diet), repackages it in 7 gram bags and encourages owners to purchase it. It can be fed to crickets, mealworms, superworms and Dubia cockroaches and greatly improves calcium content within 24–48 hours. Provide crickets with clean water, such as a wet cotton ball in a bottle cap, but no fruits or vegetables or they will consume those preferentially over the calcium enriched diet, which probably tastes like chalk.

An additional essential method of improving Ca content is dusting with calcium. To dust insects, place Ca powder in a plastic bag with the insects and lightly shake. This method can produce variable results because of type of calcium used, particle size and electro-static properties. Multivitamins never contain enough Ca to prevent Ca deficiencies regardless of what the label says. Ca carbonate is the most biologically absorbed Ca so it makes sense to use. No P should be in the Ca as insects are already high in P. A good commercial product is Rep-Cal (Zoo Med Laboratories, San Lois Obispo). Crickets will groom all calcium off themselves, within 30 minutes to several hours at most, so only offer what will be consumed quickly. The author prefers Ca without vitamin D or P as long as ultraviolet light is present. Both gut loading and dusting are recommended, owners are better at gut loading than dusting and insects can't groom out a gut-loaded diet. However if insects are left in the cage they will groom off calcium and a gut-loading diet should be available.

The third aspect to feeding insectivores is to offer a wide variety of insects. Store insects such as crickets, waxworms, mealworms, super mealworms and Dubia cockroaches, should be supplemented with commercially available silkworms and tomato horn worms, as well as wild caught seasonally available insects including moths, cicadas, fruit flies, flies, grasshoppers, bees (remove stingers), and cockroaches. Insects are easily collected at night around lights or with funnel traps. Owners often are concerned about pesticide hazards but this author has never seen that to be a problem. Fireflies are toxic to bearded dragons and should not be fed. Sowbugs (pill bugs or roly pollys) are terrestrial crustaceans which are rich in Ca and avidly consumed. Many insectivores can be trained or naturally take baby mice which are an excellent dietary supplement.

## **CARNIVORES**

This group includes all snakes and crocodilians, many lizards, and some turtles. One reason snakes remain popular is that rodents are a completely balanced diet and are easily procured; therefore snakes are well fed, remain healthy and thus are easy to keep and breed. Most pet stores now sell frozen rats and mice which should be quickly thawed in plastic bags in hot water to prevent a bacterial bloom in the

prey's gut (possible if it were allowed to thaw slowly over several hours) which could upset the predator's gastrointestinal tract. For the die-hard reptile breeder still producing mice and rats make sure they feed pelleted rodent diets, not seed mixes or dog food. Live rodents should be stunned or killed prior to becoming prey so that they don't injure the predator. Hamster, gerbils, chicks, lizards, snakes, frogs, toads or fish are also appropriate food items depending on the reptile's preference. It is important for owners to appreciate the natural history of the species they keep as an insight into what the reptile naturally eats. There are no vegetarian snakes!

Aquatic turtles do well on fish based aquatic turtle pellets, earthworms, waxworms, mealworms, crickets, whole fish (guppies, minnows, chopped trout and freshwater smelt), whole shrimp and pinkies or chopped skinned mice. Goldfish are not recommended due to frequent infection with *Mycobacteria*. Many sliders and cooters will take dark leafy greens as they get older.

## HERBIVORES

This group is the greatest challenge to feed correctly and includes turtles, tortoises and many lizards. Calcium and protein deficiencies remain a frequent problem for herbivores. A common misconception is that herbivores will select a balanced diet from the foods offered. While this may be true in natural habitat this certainly is not true in captivity. Feeding captive tortoises is an area of considerable uncertainty, variability and evolving change. Chronic nutritional disease is epidemic in tortoises fed backyard grasses, weeds, grocery store fruits and vegetables. Symptoms include hypoalbuminemia (less than 1.0 mg/dl, normal mean for wild Sonoran desert tortoises is 1.7 +/- 0.5 g/dl), anemia (< 15%, normal mean is 24-25 +/- 3%), hypocalcemia, weakness, declining to no appetite, and, in terminal stages, lethargy, edema and anorexia. Hepatic dysfunction, especially hepatic lipidosis, is often present, or other chronic disease such as mycoplasmosis, intestinal impaction or bladder stones are present. What to feed tortoises is an evolving empirical science and fraught with misconceptions. Currently, select commercial tortoise diets, grass hays, native plants consumed by tortoises in the wild, many backyard grasses and weeds, flowers, succulents, dark leafy greens and prickly pear cactus are recommended as healthier alternatives to grocery store fruits and vegetables. Tortoises should be fed very little to no fruit.

Most desert tortoises in the backyards of southern California suffer from chronic protein and fiber deficiency, carbohydrate excess and many have calcium deficiencies. Commercial tortoise diets, such as Mazuri's Tortoise Diet and Tortoise LS High Fiber and ZooMed's Natural Grassland Tortoise Food and Natural Forest Tortoise Food, and hays, tend to have better calcium levels and nutrient profiles similar to what desert tortoises naturally consume. Backyard grasses or grass hays (Bermuda, Timothy, Kentucky bluegrass, Buffalo, Brome, Tall fescue, Orchard grass but not Alfalfa hay, which is too high in protein) are also very good. Getting tortoises to eat hay and commercial foods can be tough. Much like a dog content with table food, a tortoise will eat pellets and hay once hungry enough, but not if better tasting foods are available. Use good quality hays, not stems or stalks that smell stale or moldy. Chopping the hay with scissors, or a food processor, and sprinkling or spraying the hay with water, to moisten it, helps, or it can be soaked in water for several minutes. Soaking too long will leach out nutrients. Mixing the normal food in or under the hay also helps. Pellets can be soaked in water until just soft and mixed into the greens. Be patient and persistent and tortoises will switch over to hay and commercial pellets as one gradually reduces fruits and vegetables. Sulcatas grow so large and eat so much that one has to feed them hay eventually. Backyard weeds (esp. dandelions, clover, burclovers, purslane, spurge, crabgrass, cheese weed, creeping wood sorrel and others), spineless prickly pear cactus pads & fruits (*Opuntia ficus-indica*), dark leafy greens (collards, mustards, turnip tops, bok choy, kale, spinach, cabbage, endive), flowers (roses, nasturtiums, hibiscus, carnations, geraniums, primroses, ice plant and cactus flowers), leaves (Mulberry, grape, hibiscus, squash) can also be fed. One can also plant plants naturally eaten by desert tortoises, see the Arizona Game and Fish Department site ([www.azgfd.gov/w\\_c/documents/NativePlantsforDesertTortoises\\_2008.pdf](http://www.azgfd.gov/w_c/documents/NativePlantsforDesertTortoises_2008.pdf) <VIN editor: link updated May 1, 2015) and California Turtle & Tortoise Society site ([www.tortoise.org/general/wildplan.html](http://www.tortoise.org/general/wildplan.html)) for good ideas.

Be aware of several persistent widespread misconceptions. Members of the Brassica family (cabbages, kale, mustard greens, broccoli, cauliflower, Brussels sprouts) are thought, but not proven, to

cause thyroid problems (goiter) if fed exclusively long term, but are harmless in moderation as part of a balanced diet. Thyroid disease appears rare in tortoises, even Galapagos and Aldabra tortoises, and its association with feeding Brassicas has not been validated. Foods rich in oxalic acid, such as spinach, beet greens, collards, Swiss chard (tortoises don't like Swiss chard), Brussel sprouts, and purslane are thought to bind calcium in the intestinal tract and decrease calcium absorption and theoretically contribute to calcium oxalate uroliths. The later seems widely speculative, remains unproven, and empirically not supported. There are only two reports on calcium oxalates stones ever in tortoises, one in a Moorish tortoise (the cystourolith was only 20 % calcium oxalate) and one in a wild desert tortoise, with renoliths and upper respiratory tract disease. One scientific study concluded that oxalates in desert tortoises were an incidental finding or non-pathogenic. In contrast, humans do get calcium oxalate stones, yet these foods are widely safely consumed, and only avoided in people predisposed to calcium oxalate stones. Tortoises love fruits, and will consume them preferentially over more nutritious foods, but most tortoises are not naturally fruit eaters. Red and yellow foot tortoises are more frugivorous than other tortoises and can be offered more fruit, but no more than 20% of the entire balanced ration. Fruits, in general, are mineral poor, yet high in sugars, and can disrupt the normal gut flora and may lead to fatty livers. Limit fruits to a miniscule portion of the diet, more of an occasional treat than a staple, or do not feed them at all.

Tortoises should be fed hay, pellets and vegetables on a flat board, piece of newspaper, paper plate, or plastic or metal plates or trays. Disposable feeding trays cut down on cleaning. Never feed tortoises over sand or they will accidentally ingest it. Feed as much variety as possible! The majority of the diet should be commercial tortoise chows, hay, grasses weeds and flowers. Adults should be fed a minimum of three times per week and hatchlings daily. If feeding a majority of pellets supplemental calcium and multivitamins are not needed. Young tortoises have better shell growth with commercial pellets than vegetables. If not using commercial pellets or native foods, every feeding, lightly dust food with calcium carbonate, lactate, citrate, or gluconate for juveniles. Adults only need calcium several times per month. If vitamin-fortified foods tortoise foods are not being consumed, twice a month lightly dust food with multivitamins. If the tortoises are exposed to unfiltered sunlight or indoor ultraviolet lights, vitamin D supplements are not needed, nor desired.

Plant poisoning is extremely rare in tortoises. Leopard and Hermann's tortoises regularly eat plants toxic to livestock in the same areas. Tortoises either avoid poisonous plants or are more resistant to their effects, unless no other forage is available. Some exceptions include Rhododendrons (grayanotoxins cause flaccid paresis), oleanders, chinaberry trees, tree tobacco and toadstools.

## **OMNIVORES**

### **Box Turtles**

In the wild, box turtles eat everything they come across. In captivity, the healthiest box turtles eat whole skinned or pinkies. Box turtles will also eat soaked box turtle or aquatic turtle pellets, earthworms, snails, slugs, isopods, insects, mushrooms, and dark leafy greens. Small amounts of raspberries, black berries, Mulberries, and strawberries can also be given.

### **Bearded Dragons**

In the wild juveniles consume 50% plant material and 50% animal material, adults consume 90% plant material and 10% animal material. Suitable vegetables include calcium dusted dark leafy greens (kale, collards, mustards, turnip or beet tops, spinach, dandelions, cabbage, bok choy, broccoli rape, and lettuces such as Romaine, red leaf, green leaf or Boston lettuces, but not iceberg lettuce), carrots, squash, zucchini, peas and beans. Flowers such as roses, nasturtiums, carnations and hibiscus are also good. Dragons should be fed a wide variety of gut loaded insects as previously discussed. Commercial pelleted (not cubed) bearded dragon foods can also be fed. Baby mice can be offered several times per month. Even though bearded dragons love fruits, they are not recommended. Juvenile growing animals can be fed daily, adults should be fed every other day to every third day if obese.

## **Obesity**

Obesity is all too common in bearded dragons, monitors and red eared sliders. As with all creatures, obesity is not healthy, decreases longevity and increase mortality. Obese animals feeding should be reduced to EOD, then twice weekly for bearded dragons, weekly for monitors and red-eared sliders. Gradual weight loss is the goal, weight checks on a monthly basis keeps the owner on track with encouragement. Eliminate fruits for bearded dragons, offer more insects and greens. For monitors eliminate rodents and meat (even low fat turkey) and provide insects. For sliders feed less and offer more greens if adult. Hibernation is indicated for healthy dragons and sliders.

The veterinarian must evaluate dietary history on a regular basis to keep their reptile patient healthy. With this basic information you can make a tremendous impact on the health of herps in your practice.

## **REFERENCES**

1. Boyer T. *Essentials of Reptiles: A Guide for Practitioners*. Lakewood, CO: AAHA Press; 1998.

Allen M, Oftedal O. Dietary manipulation of the calcium content of feed crickets. *J Zoo Wildlife Med*. 1989;20(1):26-33.

Finke M, Dunham S, Kwabi C. Evaluation of four dry commercial gut loading products for improving the calcium content of crickets, *Acheta domesticus*. *J Herp Med Surg*. 2005;15(1):7-12.

Finke M, Dunham S, Cole J. Evaluation of various calcium-fortified high moisture commercial products for improving the calcium content of crickets, *Acheta domesticus*. *J Herp Med Surg*. 2004;14(2):17-20.