All Creatures Animal Hospital

Herbivores, Omnivores, Insectivores, Carnivores, OH MY! Reptile Nutrition

Feeding a Nutritionally Complete Insectivore Diet Includes:

- Feeding a nutritionally complete calcium-rich diet to insects
- Dusting insects with calcium daily and multivitamin 1-2 times monthly
- Feeding a wide variety of insects, crustaceans, annelids, and rodent pups

Insectivores and the Insects They Eat

Insectivores include a variety of lizards, most amphibians, some turtles, and a few snakes. They eat a variety of insects, arachnids (spiders), annelids (segmented worms), and crustaceans. The nutritional requirements of most insectivorous reptiles are unknown so nutritionists have to extrapolate from better known species, such as the rat or other carnivores that have known NRC (National Research Council) requirements. The NRC provides expert advice based on sound scientific evidence. Calcium and Vitamin A and D levels are below the NRC requirements for rat growth and for carnivores. Consequently, Vitamin A and Calcium deficiencies are the most common nutritional diseases in reptiles and amphibians.

Based on studies of several insect adults and larval forms, insects are deficient in **calcium** and multivitamins. All invertebrates are a good source of **protein**. Invertebrates contain little to no **carbohydrates**. Larval insects (except silk worms) have high **fat** content, especially mealworms, waxworms, and butterworms. Insects have significant amounts of **fiber** (highest in meal worms, lowest in silkworms). Invertebrates appear to be a good source of **essential amino acids** (except for wax and superworms) and adequate sources for **trace minerals including copper, iron, magnesium, and zinc** (except superworms, giant mealworm larva, waxworms, and silkworms). Most invertebrates contain sufficient **vitamin E** except mealworms and superworms. **Vitamin B12** is deficient in all larval insects. **Thiamine** is deficient in crickets, superworms, giant and adult mealworms larva.

Omnivores

Omnivores consume various amounts of plant and animal material. Many aquatic turtles, box turtles, wood turtles, forest tortoises, sea turtles and lizards are omnivores. Many are more carnivorous as juveniles than as adults due to the high energy demands for growth. Refer to the sections covering herbivores, insectivores and carnivores for additional information.

Since each species is unique, refer to the individual handouts on the ratio of plant to animal requirements for your individual species.

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*Fireflies are **toxic** and should be avoided.*

Gut Loading Insects

Gut loading is feeding a **nutritionally complete calcium enriched (~8%Ca) diet** to improve the nutritional content of the insect. Assume all store bought insects are nutritionally inadequate at the time of purchase. To correct this deficiency, all insects should be fed a high-quality gut loading diet for **12-48 hours** prior to being fed to the reptile. Several studies have been done to determine the most efficient source for feeding a nutritionally complete diet to insects. A high-quality gut loading diet that is calcium enriched (>8% Ca DM) should be fed, such as Mazuri Hi Calcium Gut Loading Diet. These studies also showed <u>not</u> to feed fruit, gel water cubes, or vegetables. The insects will preferentially eat these items over the calcium rich diets resulting in a negative Ca:P ratio. Instead, offer water on a cotton ball soaked with water in a bottle cap or on a damp paper towel. Finally, do not refrigerate feeder insects. They should be maintained at their optimal temperature zones: Dubias 90-95*F, Crickets 75-92*F, Silkworms 78-85*F, Hornworms 70-85*F, Mealworms 72-81*F.

Dusting Insects

All insects should be dusted with a calcium rich (calcium carbonate) powder prior to feeding to the reptile. Studies have shown that dusting, in addition to gut loading, will enhance the Ca:P ratio at or above 1:1. Remember a healthy Ca:P ratios for most vertebrates is 1-2:1. Since the insects will groom the calcium off, it is important that the reptile consume the insects within 20-30 minutes. Any remaining insects should be removed.

Insect Variety

Insectivores naturally consume a wide variety of insects. This should be replicated in captivity. Crickets, mealworms, waxworms, super mealworms, and dubia cockroaches are the most common insects fed to our captive reptiles. However, these should be supplemented with silkworms, black soldier fly larvae (Phoenix worms), tomato horn worms, bean beetles (*Callosobruchus maculates*), fruit flies (*Drosophila melanogaster*, *D hydei*), springtails (Collembolands), and wood lice (European wood lice, *Porcellio scaber*, dwarf tropical wood lice, *Trichorhina tomentosa*), as well as wild caught seasonally available insects such as moths, cicadas, flies, grasshoppers, bees (remove stingers), cockroaches, and crustaceans, such as wood lice and sow bugs (pill bugs or roly polys). Wild caught insects do not need to be supplemented if fed immediately. Baby mice and annelids (ie earthworms) are also excellent dietary supplements. It is highly recommended to feed as wide a variety of invertebrates as possible, not just 2 or 3. Care should be taken to avoid having insects chew on the reptile.

Herbivores

Herbivores include a variety of lizards, turtles and tortoises. Herbivores eat 100% plant material. Most people assume this means feeding spring greens you get from the store. Unfortunately, it is not that easy. There are a few reasons why feeding herbivores correctly is the greatest challenge. First, the nutritional value of plants vary seasonally, annually (dependent on rainfall), phenologically (freshest eaten first), and between habitats. Second, many reptiles, including some tortoises, consume over 100 different species of plants. This dietary diversity is difficult if not impossible to replicate in captivity. Third, Cheloniidae (sea turtles), Testudinae (tortoises), and some Agamidae and Iguanidae (iguana-like species) undergo an ontogenic shift in diet as they mature. As adults, they are true herbivores. But as juveniles, they are insectivores, carnivores, or omnivores, including

the bearded dragon and several species of water turtles.

One thing that is consistent and required among all the herbivores is that they **all require UVB** light.

Feeding Herbivores

Salad-type diets are problematic because commercial fruits and vegetables produced for humans are too low in calcium, fiber, trace minerals, and some vitamins. The protein content is inconsistent and many are too high in carbohydrates. It is important to provide a wide variety of plants, especially ones that the reptile would eat in the wild (if it is known).

Many tortoises require diets high in fiber. Most grasses and hays, except for Kentucky bluegrass and alfalfa, approach or meet the nutrient level for desert tortoises. Clover and alfalfa, which are high in calcium, are also higher in proteins. Too much protein can lead to rapid growth and skeletal deformities.

It is difficult to provide a balanced diet with greens alone. It is recommended to provide a commercial pelleted diet in addition to the greens, provided there is one available. Refer to "Manufactured Diets" and "Reading Food Labels" for additional information.

Feeding the Picky Eater

So how do you get your reptile to eat appropriate food items? Stop offering their favorites.

They will eventually eat what they are offered once the better tasting foods are no longer available. It is similar to getting a dog off of table food. They will hold out until hunger gets the best of them. Feeding less frequently will encourage them to try new foods.

To increase the palatability of hay, use good quality hay, not stalks, and cut the hay into smaller pieces. Spraying the hay with water and soaking the pellets can also improve the palatability. Mixing chopped hay or softened pellets into the greens can also increase acceptance. In the end, patience and persistence is the key to success.

Common Misconceptions:

*Members of the Brassica family (cabbage, kale, mustard greens, broccoli, cauliflower, Brussel sprouts, bok choy) cause **goiter**. It has not been validated that Brassicas cause goiter. Goiter is rare in tortoises.

*Oxalates cause **stones**. Calcium oxalates can cause calcium oxalate stones in humans. However, reptiles develop *urate* stones not oxalate stones.

*Oxalates **bind calcium** making it unavailable to the animal. Foods that have an oxalate:calcium ratio is >2 (spinach, beet greens, sorrels, purslane) can bind calcium if fed with other foods. *However*, those with a ratio <2 (prickly pear cactus, collards, swiss chard, dandelions, kale, turnip greens, Brussel sprouts, parsley) are good sources of calcium. While many mammals have bacteria in the gastrointestinal tract that breaks down the oxalates, it is unknown if reptiles have this ability as well.

"Carnivores require high levels of protein and fat and low levels of carbohydrates."

Carnivores

Carnivores include all snakes, crocodilians, adult amphibians, and most aquatic turtles and lizards. Carnivores require high levels of protein and fat and low levels of carbohydrates.

Whole vertebrates are a nutritionally complete food that does not require supplementation. Mice, rats, rabbits, hamsters, gerbils, chicks, lizards, frogs, toads, or fish are all appropriate food items. Muscle meat and viscera lack bone (calcium), and therefore are nutritionally inadequate for carnivores.

Feeding live prey should be avoided. Injuries caused by prey animals are common. Frozen whole animals are nutritionally sound. However, they should be completely thawed in warm water prior to feeding. Freshly killed prey is also acceptable.

The rodent life stages:

*Pinkies: neonatal without fur; have an almost even Ca:P ratio

*Fuzzies: 5-9 days, have fur, positive Ca;P ratio

*Hoppers: 2-2.5 weeks old, eyes open

*Weanlings or Small Adults: 21-25 days, weaned

*Adults

If the snake is resisting the rodent you are feeding, there are a few tricks to encourage them to eat. Scenting involves washing the rodent and then applying the scent of the preferred natural prey. Braining also works by forcing the brain material of a pinkie mouse though the skull or nostrils onto the snout and then left with the snake.

Fish is also used as a food source for snakes, turtles and crocodilians. Whole fish is a relatively good source of most nutrients except thiamine and vitamin E. Many marine animals, such as clams, herring, smelt, and mackerel contain thiaminases, enzymes that destroy or inactivate thiamin, and need to be supplemented with thiamine. Trout and most freshwater fish do not contain thiaminases and do not require supplementation. Vitamin E is abundant in fresh fish, but is depleted in frozen fish. Frozen fish should be used within 4-6 months and should be supplemented with Vitamin E. A variety of fish types should be offered. You can also offer rodents, snails, slugs, earthworms, shrimp, krill (frozen, not freeze dried), or pelleted commercial diets.

A proper diet is one of the most important components of care for any pet. In reptiles and amphibians, this is complicated by the fact that there is little nutritional research available. The diet consumed in the wild is not usually available in captivity. A diet has to be put together from available items that are as close to the natural diet as possible and is accepted by the animal. Let us help you put together a proper diet for your pet.

All Creatures Animal Hospital
Quality Medicine in a Caring Environment

2001 N Linview Ave
Urbana, IL 61801

Phone: 217-328-4143 **Fax:** 217-337-3068
E-mail: staff.allcreaturesah@outlook.com
Website: allcreaturesah.com