

NUTRITION OF SNAKES, AN IMPORTANT ISSUE ON CARING



*Ron Kivit,
Jan Ligthartstraat 51, NL-1068 PB
Amsterdam, The Netherlands.
Phone/fax: +31-20-6190936*

■ INTRODUCTION

Knowledge on good care of snakes is ever increasing. Especially on diseases, their occurrence and treatment, articles are regularly published. Also breeding and the stimuli to urge the animals to mate are regular issues for publications. On the nutrition of snakes, however, little is written. Only out of necessity, like the discovery that thiaminase (anti-vitamine B1) in fish can cause problems for fish-eating snakes (Zwart, 1982), nutrition might be the subject for publication. This is in contrast to articles on lizards, tortoises and amphibians, of which the keepers are aware that good nutrition is an essential part of good caring, and the key to successful breeding. Therefore, I will try to explain in this paper what good nutrition will do, what components an animal needs and how you can achieve that some animals will accept the food that they rather refuse to eat.

■ ENERGY

During metabolism energy is produced which is required for movement, breathing, etc. (Holsheimer, 1980). Energy is also required for the production of proteins that are essential for muscles, scales and skin.

Furthermore, energy is needed for the formation of fat and the production of eggs. Not all the food is converted into energy. Part of it is lost.

Energy can roughly be classified into five parts, i.e.:

- the bruto energy, the total energy present in the total amount of food.
- the indigestible energy, present in indigestible food ingredient (e.g. fibers) which are excreted as faeces via the rectum.
- digested energy, the sum of bruto energy minus indigestible energy.
- urine energy, breakdown products of digested proteins are present as uric acid in the urine.
- turnover energy, the sum of digested energy minus urine energy.

Furthermore, another two forms of energy are recognised, for snakes however less important: thermic energy, used for maintaining the body temperature, and waisted energy that leaves the body unused.

■ COMPONENTS

Proteins are an important component of food. A shortage of proteins can cause a lot of problems, since an important part of animal tissue is composed of proteins. The chemical composition of protein is carbon (51-55%), hydrogen (6.5 - 7.3%), oxygen (21.5 - 23.5%), nitrogen (15.5 - 18%) and sulphur (0.5 - 2%). Moreover,



Photo: Ron Kiriil

The quality of nutrients supplied by the mother determines the survival of the progeny.

phosphor, iron, copper, zinc and manganese can occur. Proteins are composed of amino acids. The mean nitrogen content is 16%, but can vary between 8 and 32%. Some amino acids are produced by the animal itself, but others have to be present in the food, since animals are not capable of forming them. Therefore, it is important that the diet is varied and that all components are present for a good health and reproduction of the animal. For example one can think of the formation of eggs, for which the presence of sufficient calcium in the body is important. Not only for the formation of eggs, but also for egg-laying. Important to note is that a bad balance in amino acids can cause disorders in metabolism and fatty degeneration. In short, correct food, a varied menu and the right amount of food are of eminent importance for keeping and breeding snakes. It is always difficult to say what the right amounts of food for snakes are, but by comparing a wild-caught animal and an animal which is kept in cap-

tivity for already a long time or a captive-born animal, generally the latter are often fed excessively, which is bad for their health.

I often hear snake keepers say that an day-old chick is just an egg with legs and has a low nutritional value. That is not true. To illustrate this, Table 1 shows the chemical composition of day-old chick, chicks, rats and mice according to Holsheimer (1980).



Photo: Ron Kiriil

This X-ray shows that no bones are broken during strangulation of the prey. The prey (in this case rats) is swallowed in one piece.

Table 1. Chemical composition of day-old chick, chicks, rats and mice.

| | | one day chicks | chicks | mice | rats |
|--------------------------------------|-------|-------------------|--------|--------|--------|
| number of analyzed animals | | 60 | 10 | 30 | 10 |
| average weight | (g) | 40.4 | 386.7 | 26.7 | 325.7 |
| dry weight | | 27.0 | 33.5 | 35.4 | 34.4 |
| bruto energy in KCal per | kg | 1623 | 1986 | 2067 | 1988 |
| raw protein (6.25 x N _i) | % | 16.8 | 19 | 19.8 | 21.6 |
| raw fat | % | 6.4 | 9.0 | 8.8 | 7.6 |
| raw fibers | % | 0.27 | 0.67 | 0.60 | 0.82 |
| ashes | % | 1.9 | 3.2 | 3.7 | 3.4 |
| calcium | % | 0.36 | 0.65 | 0.84 | 0.69 |
| phosphor | % | 0.26 | 0.47 | 0.61 | 0.51 |
| ratio Ca and P | | 1.38:1 | 1.38:1 | 1.38:1 | 1.35:1 |
| zinc | mg/kg | 33.1 | 52.8 | 47.7 | 43.3 |
| copper | mg/kg | 0.9 | 1,5 | 2.8 | 1.5 |
| mangane | mg/kg | 0.7 | 3.3 | 4.1 | 2.5 |
| iron | mg/kg | 33.0 | 49.1 | 84.6 | 58.9 |
| sodium | g/kg | 1.2 | | | |
| chlorine | g/kg | 0.7 | | | |
| potassium | g/kg | 1.1 | | | |
| magnesium | g/kg | 0.2 | | | |
| selenium | mg/kg | 0.15 | | | |
| thiamine | mg/kg | 3.6 | 2.8 | | 4.6 |

This table needs some explanation. A closer look shows that the nutritional value of day-old chicks is indeed lower than that of chicks, mice and rats, while the nutritional value of chicks is about the same when compared to mice and rats. In each of the constituents, day-old chicks score lower, both in % as well as in mg/kg. This does not necessarily have to be a disadvantage as long as day-old chicks are part of a variable menu and not the only food. Are day-old chicks the only food source, than is it essential to offer larger amounts in comparison to rats, mice or chicks to supply the same nutritional value. Moreover, additional calcium needs to be supplied, since the percentage calcium in day-old chicks is very low. The ratio calcium : phosphor (Ca : P) however is equal to the other prey animals. Carnivores often obtain too low levels of calcium and too much phosphor. That is also the case here. An ideal ratio Ca:P would be 1:0.5 to 1:0.6. In all cases it is therefore advisable to supply additional calcium. This can be supplied as calcium lactate (milk) or calcium carbonate. However, a prey dusted with Gistocal is often not accepted by the snake, because she does not like it. Therefore another way of administering has to be found (see chapter 'MENU').

■ VITAMINS AND MINERALS

A vitamin is an organic compound, derived from a plant and/or animal which is part of the diet. Moreover, the animal is often capable of making certain vitamins itself and vitamin D can be supplied by exposing the animal to UV-light. Vitamins are essential for growth, health and reproduction. In addition there are antivitamins that can hinder the action of vitamins because they have the same chemical structure but can not take over or even counteract their function. Both a shortage as well as a surplus of vitamins can damage the health of the animal.

Avitaminoses

Avitaminoses is a deficiency of one or more vitamins and can, apart from chronic or acute deficiencies, often lead to death. Avitaminoses can have a number of causes:

- the animal is fed too little or too one-sided food,
- the food is too old as a result of which vitamins were destroyed (e.g. prey that has been kept too long in the freezer),
- antivitamins present in the food prevent the uptake of vitamins from the food into the blood,
- the animal does not eat enough thereby taking up too little vitamins,
- the mother animal did not supply enough vitamins to the egg, which can cause the embryo to die. Steehouder (1994) only got unfertilized eggs from a female of a Plains Ratsnake (*Elaphe guttata emoryi*) after feeding this female the whole year with mice from the freezer. In previous years, and the years thereafter, when feeding freshly killed mice, all eggs hatched normally.

Hypervitaminosis

Hypervitaminosis is a surplus of vitamins, which can lead to growth disorders and organ abnormalities. I do not know any cases of hypervitaminosis in herpetology but from keepers of lizards I know cases in which the insects that were fed were heavily dusted with calcium- and vitamin supplements. Vitamin A is necessary for maintaining the epithelial cells (mucous membrane), sight, growth, reproduction and for a good progress of the slough. In case of skin damage or a bad slough, supplying vitamin A can be a good remedy. The dosage should be:

- orally 5000 IE/kg for five days,
- intramuscular 30,000 to 100,000 IE/kg (depending on the seriousness of the disorder) once-only.

A varied menu is usually sufficient to supply an animal with all the necessary vitamins, except for vitamin D, which is limited in animal food (Boonman, 1987). Vitamin D is needed to prevent skeleton disorders and a decreased growth. A deficiency of vitamin D can also lead to muscle weakness. For sure it has an effect on gravid females, eggs and the young. Both a deficiency as well as a surplus of vitamin D are dangerous. One possibility is to add a vitamin D supplement to the prey, however, you never know if the dosage is right. Another possibility is supplying UV-light by which provitamin D is converted to vitamin D. The advantage of UV-light is that provitamin D is converted to vitamin D without the danger of an overdose. The wavelength of UV-light should be around 300 nm. UV-light with a wavelength of less than 300 nm can be dangerous, although this is only partial true for snakes, as it can cause burns on body-parts that are not protected by horny tissue. In reptiles generally the eyes, in amphibians the entire body. For snakes the danger is clearly less as the eyes are covered by a (transparent) scale. However, one should be careful with UV-light.

Minerals

Minerals and trace-elements are elements that are necessary for metabolism, growth and replacement of old tissue. A chronic shortage of these elements can cause weakness of the skeleton, a surplus can cause poisoning.

The six vital minerals are:

- calcium (Ca)
- chlorine (Cl)
- phosphor (P)
- potassium (K)
- sodium (Na)
- magnesium (Mg)

The ten vital trace-elements are:

- iron (Fe)
- zinc (Zn)
- copper (Cu)
- sulphur (S)
- iodine (I)
- manganese (Mn)
- chromium (Cr)
- selenium (Se)
- cobalt (Co)
- molybdene (Mo)

A varied diet is usually sufficient to supply the animals with the correct amounts of these elements.

■ MENU

Besides diseases caused by endoparasites and ectoparasites, an animal can show disease symptoms when fed too one-sided food from which it can not get enough nutrients, vitamins and minerals. A varied menu is therefore essential. In the case of snakes we are unfortunately often limited to those prey animals that are relatively easy to breed and are cheap. Feeding Emerald Tree Boas (*Corallus caninus*) with parrots and bats would of course be ideal but not very practical.

Also some animals will not accept the food that is offered, because they simply do not like it. There are a number of tricks which we can use to make the animals eat the food that we offer them. Young Green Tree Pythons (*Morelia viridis*) in nature eat mostly young lizards. When you breed this species it is impossible to offer them young lizards, because they are relatively expensive and you want to feed rodents to the snakes as quickly as possible. In my experience about half of the new-born animals will eat nest-mice voluntarily after the first slough. After that an additional 40% of the young snakes will eat by applying a few tricks. The other animals have to be force-fed (sometimes only once). The tricks consist of washing a new-born mouse with water and soap, and supplying it with a



Photo: Ron Kibini

A young Tiger Python eats a day-old chick of which the crop is filled with Carmix.

scent that attracts the young snakes. This can be the brains of the dead mouse that are pushed out of the skull and spread over the body. The mouse can be rolled through an open-cut one-day chick, after which even some feathers can be attached to it or the mouse can be covered with a piece of shedded skin of a lizard. Sometimes also the wrong type of food is offered without realizing that the young eat different food than the adults. In nature they also do not only eat newborn mice. A good example of this is the saw-scaled viper (*Echis carinatus*). Adults usually eat rodents and are not very difficult to keep. I know however of one case in which the young refused all food offered. Only after the young were offered locusts and crickets with the idea 'if it does not help it sure will not harm them' they started to hunt actively and all ate the food that was offered.

Young animals may refuse to eat because they go into hibernation first. This goes for those animals from temperate climates that are born late in the year like for instance the four-lined snake (*Elaphe quatuorlineata*). In that case it is better to cool down the animals and offer them food later (Langeveld et al., 1994). This is always

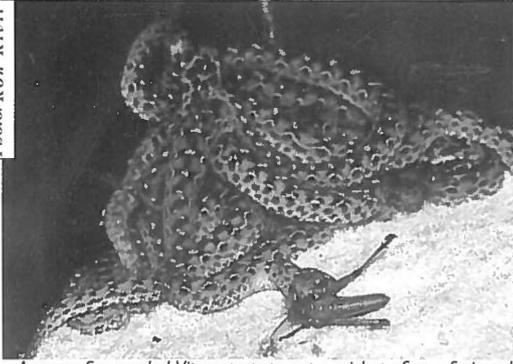
better than force-feeding as this does more damage than it does good. Force-feeding therefore is the last option when all other possibilities have failed.

Sofar I have fed my animals with rats, mice, guinea pigs, hamsters, rabbits, day-old chicks and pigeons. I have to say that not all animals except day-old chicks. I also own animals that do not accept rabbits. The once so beloved gerbils are missing in this list because I had some bad experience with them. After one animal had eaten eleven of these it suffered from a stomach perforation caused by the whiskers and the hairs at the end of the tail. This animal vomited a lot of slime which contained these hairs and it was ill for almost a year. Fortunately it was in such a good condition that it was able to survive one year without food. I could remove the whiskers and the hairs on the tail but I decided to remove the gerbil from the menu.

If we offer a lot of day-old chicks it is important to feed extra calcium. This can easily be done by stuffing for instance Carmix in the crop of the chick. With this the animal is also fed some vitamins and minerals. The composition of Carmix (or Carnicon as it used to be called) is as follows:

- raw protein: 18.5%
- raw fat: 10.5%
- raw fibers: 0.5%
- ashes: 30.0%
- Vitamin A: 275.000 IE/kg
- Vitamin D3: 45.000 IE/kg
- Vitamin E: 500 mg/kg

It is essential also to feed your prey animals well. They are finally the basis of the food that we offer our snakes. You can of instance feed your mice and rats with laboratory food from Hopefarms or with food of an equal composition like Muravo. Herbivores like rabbits



A young Saw-scaled Viper starts to eat a cricket after refusing all other prey. Later on the other young followed.

should be fed with vegetables that are thoroughly washed or even better, are grown in an environmentally safe way.

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