

## Live Feed Enrichment

Rachael Antwis, Hon. AArk Research Assistant, Antwerp Zoo, Belgium,  
rachael.antwis@googlemail.com

Dr Robert K. Browne, AArk Research Officer, Royal Zoological Society of Antwerp, Belgium,  
robert.browne@gmail.com

Adequate nutrition of amphibians is required to ensure:

- rapid growth and normal development
- successful reproduction
- the production of fit and healthy offspring
- health and low mortality rate
- adequate calcium metabolism

The most common nutritional deficiency in captive amphibians is lack of calcium metabolism. Low calcium ingestion or low serum vitamin D<sub>3</sub> prevent calcium uptake through the gut. This leads to serious problems such as metabolic bone disease, which can exacerbate nutritional problems through reducing prey capture. This cycle impacts on reproductive ability and success, and may lead to premature mortality. It is also important to provide a wide range of proteins, lipids, and other macronutrients, vitamins, and vitamins and minerals that are necessary for health. Recent studies have shown even small deficiencies in unsaturated fatty acids can result in pathologies.

The effect of feed quality on feeder insects nutritional value prior to the 12 hrs or so before nutritional supplementation is not well documented. Most studies have concerned the use of calcium supplements to address the low calcium levels in feeder insects. However, it is probable that the provision of high quality feed fed for the days prior to enrichment would improve the nutritional value of feeder insects. The most accessible source of high quality feed are complete diet commercial pellets for fish, birds or mammals. A mixture of ground vegetarian turtle pellets and carnivore pellets (fish) would provide a possible diet.

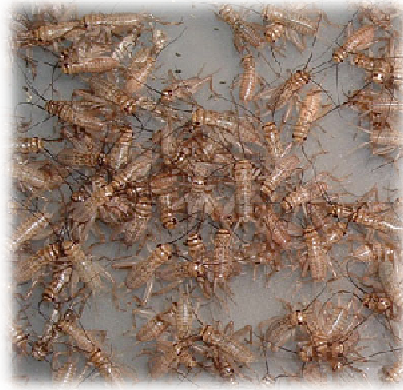
Vitamin D<sub>3</sub> can be synthesised in the skin through the effect of UVB. Other vitamins and minerals can be applied topically. In special cases vitamins, minerals and even macro-nutrients such as proteins or lipids can be supplied by injection into waxworms. Unlike crickets or mealworms, waxworms can accommodate the required increase volume because of their elastic cuticle. However, most nutrients are normally supplied through regular amphibian diet. Part of these nutrients can come from the feeder insect, part through external dusting, and part through nutritional supplementation or "gut loading".

Simply, physically shaking the feeder insects up in a plastic bag/bucket with a suitable multi vitamin/mineral powder has been practiced widely for decades. The insects can be held in cool conditions prior to feeding to make their immediate capture by amphibians easier. Unfortunately, much of the dusted supplements are lost from feeder insects within minutes.

*Right: Small crickets or flightless fruit flies can be dusted with vitamin/calcium powder and then fed immediately to small amphibians.*



The easiest and most economical way to provide a suitably nutrient-rich diet for amphibians is through the nutritional supplementation of live feed. Dusting of live feed alone is inefficient because most dust is lost shortly after application. The principle of nutritional supplementation is to provide live feed a palatable diet of very concentrated nutrients for several hours before their feeding to amphibians. The live feed ingests the nutritional supplementation diet and becomes dusted with the diet. As the nutritional supplementation diet normally contains unsaturated fats these also coat the cuticle of the live feed and assist adhesion of further nutrients.



Above: Small crickets before nutritional supplementation with *Spirulina* based diet.



Above: Small crickets after nutritional supplementation with *Spirulina* based diet. Their darker colour and the green line of supplementation diet can be seen dorsally.

A proven nutritional supplementation mixture uses four ingredients. A base of ground fish feed, *spirulina*, fish oil, and vitamin-mineral mix. Ground fish food pellets are an excellent source of protein, calcium and most nutrients. *Spirulina*, a blue-green algae, is high in carotenoids, unsaturated fatty acids, and micro-nutrients. Fish oil is high in unsaturated fatty acids and vitamin A. Vitamin-mineral mix provides other nutrients for a balanced mix. Vitamin D and calcium powder is often used in nutritional supplementation mixtures. However, although excessive calcium does not normally illicit health problems in amphibians, hypervitaminosis can cause problems and care should be taken not to

over-supplement. Problematic in deciding the degree of supplementation are the small number of scientific studies.

A recommended nutritional supplementation mixture consists of ground fish feed mixed with 20% *spirulina* and 5% vitamin mix. To this is added fish oil until the mixture is crumbly. Simply a mixture of 75% *spirulina* with 25% vitamin-mineral mix is also satisfactory but less varied. The amount of vitamins varies considerably between these two mixtures. However, both have been used with apparent benefit and without harm with amphibians. Unfortunately, although we do know that the provision of micronutrients should benefit amphibians their levels of the variation of these between different amphibian taxon is still uncertain.

## Crickets

Crickets up to the length of the width of the anurans mouth are a suitable feed for most adult frogs, toads and other amphibians, and are easily enriched. Crickets for enrichment should be placed in containers with the nutritional supplementation mixture 6-8 hours before feeding.

Crickets should be kept in a warm dry environment and will thrive without moisture for the nutritional supplementation period. If a higher level of nutritional supplementation is required, smaller crickets can be used, as these have a higher surface area to volume ratio than larger crickets, and more fine surface hairs. This gives a higher degree of dusting but not of internal nutritional supplementation.

## Diptera

*Right:* Flies can be nutritionally supplemented with a paste made of the nutritional supplementation mixture with water provided within their box so they carry it with them when entering the amphibian enclosure. There are numerous other 'recipes' using fluids to such a fruit juice with vitamins to enrich flies.



### Fruit flies

*Left:* Fruit flies fed to metamorphs or small amphibians such as Dendrobatids can be enriched prior to feeding out using a slice of banana coated with vitamin mineral mix.



### Mealworms

*Right:* Mealworms are particularly low in calcium and high in fat. Mealworms can have their nutritional value increased through feeding a

high-calcium substrate such as wheat bran/calcium cricket mix enriched with *Spirulina* and vitamin powder. Mealworms can also be fed ground fish pellet nutritional supplementation mixtures as described for crickets but will then only survive for a few hours. This could be because the oils in this supplement block their stomates.

