

## METABOLIC BONE DISEASE AND HOW TO PREVENT IT

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Metabolic bone disease (MBD) is caused mostly by calcium and/or vitamin D deficiency. However it is complicated nutritionally by vitamin A, protein deficiency and a lack of trace elements as well as behaviour and genetics. Although it is always considered a disease of captive birds it is seen in wild birds, e.g. Collared Doves (*Streptopelia decaocto*) in the UK (Cousquer, 2007). MBD could be a limiting factor in bird's distribution. Most birds have ranges where they can survive and ranges where they cannot. Diet is a limiting factor.

It is a sad fact that the majority of pet parrots are fed on nutritionally deficient diets. There are several factors that encourage this to happen but these are mainly due to the ignorance of many bird owners and also owners of pet-shops.

The majority of pet psittacine birds are given a seed-based diet. Seeds fall into two categories: sunflower seed, peanuts and pine nuts, are large seeds that contain a lot of oil. Small seeds such as safflower, hemp, millet and canary seed contain mainly carbohydrate. Seeds are high in calories; low in calcium with a poor Ca/P ratio; low in most vitamins; have either a low protein content or a limiting essential amino acid, usually lysine or methionine. Seed-based diets have little to recommend them nutritionally but they are easy to store and do not deteriorate visually. They are also a universally attractive diet to many parrots. In many pet shops the seed quality is poor, is stored for an unspecified time and in unspecified circumstances and is often seed that has failed to make the grade as fit for human consumption. There is no 'best before' date on the bag. The seed-based diet is almost never subjected to nutritional analysis and if an analysis of a mixed seed diet is offered it is usually book-based and therefore relatively unrelated to the diet in hand.

Although many owners attempt to feed a varied diet the birds are able to select an unbalanced seed-rich diet. Some Grey Parrots eat nothing but sunflower seed. Also most birds are offered far too much food, further enabling the bird to eat only the seeds that it wants. A Grey Parrot will maintain its body weight on a level tablespoonful of sunflower seed per day, after that it doesn't need to eat anything else.

The onset of clinical signs of a dietary deficiency is based on the lifestyle of the bird: productive birds show more dramatic signs more quickly.

As most parrot's diets are deficient in several vital nutrients the bird is usually presented with a multitude of subtle problems as well as major ones. So, just because one deficiency is more obvious, such as osteodystrophy in a growing baby parrot, it does not mean that this will be the only deficiency.

Captive birds of prey are less inclined to nutritional deficiency but still can have problems if the birds are productive.

Finally, every client says that they feed their birds on 'only the best', never believe them. Rely on your clinical impression: you will usually be correct.

There are many manifestations of nutritional deficiency, some are caused by a single dietary deficiency, others are caused by a combination or several deficiencies can produce similar signs.

- Poor integument: flaky beaks, scaly skin, softened claws and beak allowing overgrowth
- Poor plumage in form and colour
- Delayed or incomplete moult
- Convulsions (seizures) or muscular weakness
- Lethargy or inability to fly
- URT disease + conjunctivitis
- Renal disease and visceral gout
- Lipomata
- Susceptibility to disease
- Poor breeding: reduced libido, egg-binding, infertile eggs, deformed babies.

All the above signs can have other causes

### **SPECIFIC DEFICIENCIES**

In poultry, vitamin A deficiency causes squamous metaplasia of the mucous membranes affecting oropharynx, respiratory, reproductive, and renal tracts. The abnormal keratinisation blocks the ducts of the glands causing abscesses in the salivary and mucus glands. Carotenoids produce much of the feather colour in parrots. In vitamin A deficient birds the yellow, orange, and red colours are much duller and the green plumage (made of yellow carotenoid and blue caused by scattered light) is affected too. The coloured oil droplets in the cones of the retina contain carotenoids too. In vitamin A deficient quail it is possible to remove the colour from the droplets but the birds still seemed to be able to find their seeds easily. Vitamin A deficiency also causes chickens to have a staggering gait and ataxia; histology and chemical analysis of the bones shows poor calcification and poor bone development. Hypervitaminosis A also causes an osteodystrophy by thickening the growth plates and depressing calcification in the bones as well.

Treatment of deficiency requires not only increased vitamin A in the feed but vitamin D is also needed. Gavage with lots of vitamin A causes the signs to worsen!

Vitamin A is formed in the bird by converting beta carotene from a vegetable source: fresh vegetable such as carrot, maize or sweet corn, green beans, celery, apricots, etc.

When the original work on vitamin A deficiency was carried out by Beach (1924), it was shown that adult chickens on a severely deficient diet took two to five months to show signs – the variation was dependent on how much the bird had stored in its liver. Day old chicks put onto a vitamin A deficient diet were affected at the end of the first week if their parents were on a deficient diet too. However if the parents were well fed, the deficiency did not show until the birds were six to seven weeks old even if the chick's diet was completely deficient in vitamin A.

This scenario is typical of many deficiencies. Productive birds show signs of deficiency far sooner than unproductive. In the UK, raptors of various species are bred in an artificial manner. The females are

separate from the males and are inseminated artificially. Because the eggs are taken away the bird does not produce a clutch and continues to lay an abnormal number of eggs. If there is any degree of dietary deficiency the later eggs have poorer hatch and fledging rates than the earlier ones.

Another feature of nutrition is that of storage. Animals whose diet includes an abundance of any particular nutrient usually lose the ability to store it. Vitamin A and polar bears is the classic example. I expect that many birds are the same. There are differences between grey parrots and Amazon parrots in the way they store their vitamin D probably based around the way they metabolise and store their fats.

Vitamin D<sub>3</sub> is often deficient in pet birds, especially Grey Parrots. Various vitamin D precursors are metabolised within the skin by ultraviolet light to form Vitamin D<sub>3</sub>. Glass tends to filter out UV light from sunlight and for six months of the year in the UK there is little UV in the sunlight. As the calcium to phosphorus ratio in most seeds is poor (high phosphorus and low calcium) many parrots become seriously depleted. In birds that are laying eggs or still growing, the problem is quickly seen as egg-binding in the former and osteodystrophy with bony deformity in the latter. Grey Parrots are very prone to calcium deficiency, which manifests as convulsions or the bird will suddenly fall off its perch. Their ionised calcium (and often total calcium) level is often very low, so is their Vitamin D<sub>3</sub>.

A concern about vitamin D3 supplementation is that there seems to be no negative feedback system for intestinal absorption, unlike natural production from sunshine. Nearly all the calcium supplements supplied come with added vitamin D so it is possible for breeders to use several products and end up with too much vitamin D. In my experience this rarely happens primarily because they seldom feed anywhere near enough let alone too much!

#### **Vitamin E**

Deficiency is commonly seen and occurs because storage of seed for long times allows the oils to become rancid and the vitamin E to deteriorate. In poultry, generalised weakness due to myopathy will occur and this is worsened by deficiency in selenium or sulphur containing amino acids.

#### **Vitamin K**

The most important non-collagen protein in bone is osteocalcin. It contains certain amino acid residues that are very dependent on vitamin K as a co-factor in their synthesis.

Most seed-based diets are deficient in some essential amino acids. These are usually lysine and methionine. In productive birds: moulting, egg-laying, or growing, protein deficiency is obvious. In adult non-productive birds it is less obvious but these birds often have great difficulty in responding to disease or injury.

The majority of seed-based diets and muscle meat are calcium deficient but have adequate phosphorus.

Many other nutritional deficiencies have been described in poultry. I expect that they occur in other birds but there is little scientific evidence (not surprisingly).

## DIETARY CORRECTION

Most parrots have specific feeding times and do not usually need to eat outside them. They feed in the morning and in the evening. Parrots are vegetarian birds. They should be fed a balanced vegetarian diet and the diet should be in a form where it is difficult for the bird to be selective. The food should be fed in a quantity where the bird is kept slightly hungry and especially where it is keen to eat its next meal. Parrots (and other birds) are similar to many humans; they will eat a favourite food when they aren't hungry and will continue to do so. Unfortunately many people see this as a reason to feed the bird large quantities of this particular food.

Some people feed their birds really well on a fruit- and vegetable-based diet with a little seed. They supply protein in the form of cheese or hard-boiled eggs which is acceptable. Some owners and parrot breeders feed chicken and chicken bones; I think that this should be avoided.

A balanced vegetarian diet can be made from a mixture of fruit, vegetables and pulses. Pulses is a term used for peas and beans. The pulse mixture that I use consist of equal parts of mung beans, black-eyed beans, chick peas and marrowfat peas with half a part of soya beans (marrowfat peas are green mature peas that have been allowed to dry out naturally in the field, rather than harvested in their prime - ed).

Take 2:1 quantities of apple and raw carrot and chop them into bean sized lumps in a food processor. Add a nearly equal quantity of the pulses (soaked for 24 hours, then thoroughly washed and drained. It is also possible to gently cook the pulses rather than soak them. Chop the whole mixture into pieces about 2-3 mm in size. Add a suitable vitamin and mineral supplement and mix into the food.

This is a low calorie well-balanced food and is suitable to feed throughout life to the larger parrots. It is also suitable for the birds whilst rearing their chicks. This diet is too low in calories for small parrots such as conures and parakeets or during the winter if the parrots are kept outside without heat in the UK. These birds should have some seed added to their diet. Macaws seem to need more oil in their diet and they should have some large nuts such as walnuts, Brazil nuts, palm oil nuts.

Birds always tend to eat selectively. It is possible to prevent this by being careful about the amount of food that is fed each day. The birds should be fed twice daily. The apples/carrots/pulses mixture is fed in the morning. If it is finished, then later in the day extra food can be provided in the form of more mixture if the birds are breeding or seeds and nuts in birds that require them, especially in cold weather when the nights are short. The vitamin and mineral supplement can be changed when the birds are breeding.

There are a number of water-soluble products that are sold to supplement vitamins and minerals, especially calcium. Even when the manufacturer's instructions are followed these products do not prevent deficiency. They should not be used or relied upon.

All parrots should be provided with grit. The grit sold for pigeons is suitable. Parrots start to take it as soon as they are weaned but if oystershell grit is mixed into the pulse-based diet the parents feed it to the babies. As mixed grit contains limestone and shells as well as quartz, it is a depot for calcium as well as many mineral trace elements. Some of this has been shown in wild birds.

Tordoff (2001) showed that birds have an appetite for calcium that is assuaged by the bird selectively eating calcium. Interestingly it can also be assuaged by ingesting lead solution. A lot of waterfowl in

the UK appear to seek out lead and some work has been done that shows that feeding grit helps reduce the lead poisoning rates.

*The following studies were made to assess whether it could be ascertained if parrots required grit. The author's Pionus spp. parrots were used in this study. A mixture of soluble and insoluble grit was used. All the adult birds examined had grit in their gizzards.*

*This group of Pionus spp. parrots all rear their own young. The first year they were used to determine what age young parrots contained grit in their gizzards and whether the provision of grit was harmful to them. If grit was provided dry, in a separate container the young birds tended not to contain grit in their gizzards until they were weaned, at which time they all contained grit. The next year grit was sprinkled on the food twice weekly from before the adult birds started laying. At the time of 'surgical sexing', all the young birds were examined radiographically and all had grit in their gizzards although this was mostly soluble grit rather than insoluble grit. They contained less quartz than the proportion in the grit which suggested that the parent birds exercised choice while feeding grit. No bird showed any sign of obstruction of the gastrointestinal tract at any age.*

*As part of a separate study, pet grey parrots were examined radiographically for the presence of grit. As part of the clinical history the owners were asked if their birds were offered grit. Many birds that were not offered grit had radio-opaque objects the size of grit in their gizzards. This could be a hazard to their health. The urge to find grit would lead birds to eat unsuitable substitutes such as broken glass.*

A big drawback with 'my' fresh vegetarian diet is that it can ferment if left for a long time in hot temperatures; it also takes a long time to prepare. Pelleted diets are less prone to this. All-in-one pelleted diets are also the most convenient and suitable way of feeding single pet birds. There are a number on the market in Europe and the USA. Initially owner and parrot acceptance may be low, primarily because many birds appear not like them. The client must be educated and they must persevere. Do not attempt to force an ill bird to change diet and do not force the bird to eat the new diet by starving it. Young adventurous birds will often make the change quickly; older birds do not. It is possible to introduce the pellets into the normal diet and slowly change the quantity being offered. Over a few weeks the bird will end up eating 100% pelleted food. However it takes a 'good' owner to make this work. If the owner is sure that the bird will not eat its new diet then it is best for the vet to take control. I admit the bird and tell the owners that I am going to keep it for a week. I then place a small quantity of the pellets in its food bowl. If possible I weigh the bird. I watch its droppings to see if the faecal portion disappears. Its gut is then empty and if it is not eating the pellets it has to be fed. I usually use a baby bird food made by the manufacturers of the pellets and give this two to four times daily by crop tube. The amount of supplementary feeding depends on weight loss of the bird. Weight loss is not common and the bird usually requires feeding only twice daily. It is rare for the bird not to be eating the pellets by day five.

I tell the owners that the pellets are to replace the seed-based diet but that the bird still needs some fruit and vegetables and it can have its treats - pizza crusts, chips, nuts in small quantities. The pellets must remain as 80% of the diet. I would still give the birds grit.

In my experience many birds that are converted onto an all-in-one diet are eventually put back to their old diets by their owners, whose complaint is that the birds do not like their all-in-one diet. I think they also find it difficult to get the pellets; they are seen as expensive and are a very boring diet.

One final worry: in any study where all-in-one diets are analysed what is on the side of the bag (food analysis) does not correspond to what is in the bag. This is not surprising as the majority of food analysis carried out by most companies is either book-based, or is not carried out on every batch.

Treatment of chronic vitamin deficiencies is by dietary change. However owners should be made aware that full improvement will take at least a year. For acute problems, such as grey parrots with convulsions, more aggressive treatment is required. I tend to avoid using injectable multi-vitamin supplements. In my experience they are dangerous. Most vitamins are better given orally.

Convulsant grey parrots or birds that are egg-bound should be given subcutaneous 10% calcium borogluconate and be fed a baby bird food (10 mls for a grey parrot) with added calcium/vitamin D (Nutrobal, VetArk UK) by crop tube. The bird should then be put somewhere quiet and warm. Most birds lay their egg within a few hours. (Egg over-size as a cause of dystocia is really rare).

Raptors can also be affected by MBD. If they are reared on unsupplemented muscle meat they quickly have problems. Falcons grow much more rapidly than hawks and are more frequently affected. Some breeders rear their own food – chickens and quail and some of the suppliers also sell vitamin enhanced quail. However I have seen MBD too many times in birds fed on these whole diets to believe they work as well as everyone suggests. One reason is that the baby birds (and probably their food) are reared away from sunshine. I like to use a vitamin and mineral supplement even when the birds are on a good diet and this extends to the parents as well.

NHB's favourites:

Harrison's Bird Food - <http://www.harrisonsbirdfoods.com>

Avimix VetArk Products - <http://www.vetark.co.uk>

Pet Chef vitamins - <http://www.petchef.co.uk>

## REFERENCES

Beach, J.R. 1924. Studies on a nutritional disease of poultry caused by vitamin A deficiency. California Agriculture Experimental Station Bulletin 378.

Bendell-Young LI AND Bendell JF. 1999. Grit ingestion as a source of metal exposure in the spruce grouse, *Dendragapus canadensis*. *Environmental Pollution*. **106**: 405-12.

Cousquer, G.O., Dankowski, E.J., Patterson-Kane, J.C. 2007. Metabolic bone disease in wild collared doves (*Streptopelia decaocto*) *Vet Rec* 160(3): 78-84.

Graveland JR, Van der Wal R, Van Balen JH, Van Noodwijk AJ. 1994. Poor reproduction in forest passerines from decline of snail abundance on acidified soils. *Nature* **368**: 446-448.

Gravelands J, Berends JE. 2007. Timing of calcium uptake and effect of calcium deficiency on behaviour and egg-laying in captive great tits. *Physiological Zoology*. **70**: 74-84.

Lichovnikova, M. 2007. The effect of dietary calcium source, concentration and particle size on calcium retention, eggshell quality and overall calcium requirement in laying hens. *British Poultry Science*. **48**: 71-75.

- Proudfoot, F.G. and Hulan, H.W. 1987. Effect on shell strength of feeding supplemental sources of calcium to adult laying hens given insoluble grit during the rearing period. *British Poultry Science*. **28**: 381-386.
- Russ K. 1890. Diseases. In: *The Speaking Parrots*. Upcott Gill London 52-76.
- Ryan, T.P. 2002. Grit impaction in two neonatal African grey parrots. *Journal of Avian Medicine and Surgery*. **16**: 230-233.
- Stanford, M.D. 2005. Calcium metabolism in grey parrots: the effects of husbandry. Thesis for the Diploma of Fellowship of the Royal College of Veterinary Surgeons (2005).
- Taylor, E.J. 2002. An evaluation of the importance of insoluble versus soluble grit in the diet of canaries. *Journal of Avian Medicine and Surgery*. **10**: 248-251.
- Tordoff MG. 2001. Calcium: taste, intake, and appetite. *Physiological Reviews*. **81**: 1567-97. *This is a very interesting review. It can be found easily and downloaded from the internet. Every veterinarian should read it!*
- Van Krimpen MM, Kwakkel RP, André G, Van der Peet-Schwering CM, Den Hartog LA, Verstegen MW. 2007. Effect of nutrient dilution on feed intake, eating time and performance of hens in early lay. *British Poultry Science*. **48**: 389-98.