PROCEEDINGS OF THE

NORTH AMERICAN VETERINARY CONFERENCE

VOLUME 20

JANUARY 7-11, 2006

ORLANDO, FLORIDA

SMALL ANIMAL EDITION

AVIAN NUTRITION DEMYSTIFIED

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Nutrients are defined as the components in the diet that provide the energy to maintain life and provide the precursors for the synthesis of the structural and functional macromolecules. The macromolecules provide the majority of the diet and include lipids, proteins, carbohydrates, and water. Micronutrients are the smaller that comprise the diet and include vitamins and minerals. Essential nutrients are required for optimal health. They may be needed for metabolism and may not be synthesized in sufficient amounts to meet the metabolic demands. The quantity needed is described as the requirement of the particular nutrient.

The qualitative and quantitative components of the nutrient requirements are well known in some of the domestic galliforms, which includes chickens, turkeys, and Japanese quail as well as domestic ducks. The essential nutrients are required in similar proportions with these species and for this reason have been used as a model for psittacines.

It is very important to understand the principles behind how nutrient requirements are determined, particularly with companion birds. Few nutrient requirements have been derived scientifically for companion birds, so nutrient requirements are based on the best guess from galliforms. Even in galliforms, requirements have been determined using two methods: empirically and by calculations based on factorial summation of specific needs. With empirically based recommendations, experimental diets with graded nutrient levels are fed to a particular species. The minimal level that optimizes the birds' health and performance is considered the level requirement.

The problem with companion birds is that requirements are not well established, particularly when all the various species are considered. The other problem is that the efficiency of absorption of nutrients, especially for life stages, may not be accurate. Varying absorption efficiencies may throw off calculations. Requirements for galliforms and ducks are published as the US National Academy of Sciences report (NRC). In companion birds, a margin of safety is generally added to these NRC values to provide the "best educated guess" for nutritional "requirements" in companion birds. The AAV worked with a panel of experts in avian nutrition to provide general recommendations for psittacines and passerines and this is how these values were derived.

As avian clinicians, we realize that individual species have differing needs based on our clinical impression over time and the natural behaviors of their wild cousins. Additional concerns about feeding whole food diets in mammals and providing foods that allow our companion birds to exhibit their natural foraging behaviors is adding to a better understanding of their nutritional needs.

Birds in the wild do not necessarily select adequate diets nutritionally, although they appear to be able to balance their energy needs, amino acids, and calcium, but not their needs for other requirements. Birds in captivity do not appear to select appropriately either. A self-selected diet in African grey parrots (*Psittacus erithacus*) resulted in a diet that was deficient in a total of 12 dietary components consisting of vitamins, minerals, and amino acids.

The latest dietary approach is to provide a pelleted or extruded mixture that provides all of the required nutrients above the estimated requirements. This means that the bird gets a balanced diet with each bite. Most of these "pelleted" diets are actually extruded diets. Various seeds and grains are mixed together with the necessary vitamins and minerals to balance the formula before grinding finely. Then the mixture is placed in a pelleter if pellets are made or under high heat and pressure to make an extruded diet.

This approach to using pellets or extruded diets has greatly improved the health of companion birds over an all-seed diet but has some shortfalls. The major criticisms are that seed-eating companion birds are difficult to switch over to these types of diets; there is concern about the lack of variety of foods for species that normally select from large numbers of items in the wild; and these diets offer no opportunity for birds to display their innate foraging behavior.

As we learn more about ways to provide foraging opportunities, changes will emerge in how companion birds are fed in captivity. Presently, the addition of vegetables and fruits to the diet for variety and for enrichment suggests that nutrient dilution may occur. Theoretically, that would require that the diet be reformulated to increase the non-energy portion of the diet to reduce this problem. However, this problem becomes more of an issue when the bird is eating a smaller portion of the diet than table foods offered. The reason that this may not be observed commonly is that most of the domestic fruits and vegetables are predominately water.

ENERGY

The maintenance energy requirement is the amount of dietary metabolizable energy (ME) needed to support basal metabolism. It can be expressed as the sum of the basal metabolic rate (BMR) plus the energy required for supporting maintenance activities and thermoregulation. Understanding the energy requirements of the bird in its life stage is important for determining the amount of diet that can be fed and/or consumed. It appears that the BMR of psittacine birds is dependent on the thermal climate of the species of origin and is unrelated to food habits and water availability. The energy required for free-living birds is about 3.0−3.23 times the BMR because of their increased expenditures through foraging, thermoregulation, and defense.

Daily energy requirements have only been documented in budgerigars, so calculations for other species are based on extrapolation. Because there is correlation between daily energy expenditures and BMR,

calculations for other psittacine species are often based on the BMR with the body weight and a multiplication factor based on the housing condition. The native biology of a species influences the ability of the digestive tract to digest and absorb nutrients.

PROTEIN AND AMINO ACIDS

The essential amino acids for birds are arginine, isoleucine, leucine, lysine, methionine, phenylalanine, valine, tryptophan, and threonine. Research with chickens suggests that glycine, histidine and proline are also considered essential as their rate of synthesis is less than their metabolic needs. Research in budgerigars also suggests that, unlike chickens, they cannot synthesize enough glycine and that it is an essential amino acid for them as well. Growing chicks require greater protein requirements as well as hens laying large clutches of eggs, and birds with an increased body size.

Molt and Stress Bars

Molt results in increased protein needs. Feathers are enriched with cysteine and many of the nonessential amino acids. These amino acids are incorporated into the feather during its formation on a continual basis, while uptake from the GI tract occurs only after consumption of a meal. This means that when the protein levels in the blood stream dip, the growing feather ends up being malformed at that point. This translates to the visual manifestation of a stress bar.

As a clinician, it is important to discuss the molt and the needs for increased energy and protein during this period in birds with a heavy molt and in young growing birds. The number of stress bars and the feather quality of young birds during hand rearing or by parent rearing determines the quality of care the young bird and the parent birds received.

Clinically Observed Protein Deficiency

Rate-limiting amino acids require that more food be consumed to meet that need, leading to obesity or a possible deficiency. For example, a methionine deficiency during chick growth results in dark stress bars on feathers. Achromatosis of the wings in darkly colored birds such as chickens, ducks, quail and turkeys is associated with a lysine deficiency. In cockatiels, a deficiency of choline and riboflavin does produce achromatosis of the wings and tail.

The Deal on High Levels of Protein

High protein diets have been assumed to lead to gout in birds, but this supposition has not been supported by research. Adult cockatiels, when fed diets with up to 70% crude protein for 11 months, maintained their body weight and general body condition without evidence of renal dysfunction.

VITAMINS

Vitamins A, D, E, and K are fat-soluble vitamins and their excretion is more problematic than the water-soluble ones.

Vitamin A

Vitamin A has two basic functions of vitamin A in cells—the hormone-like regulatory actions of retinoic acid and the photoreceptor actions of retinal. The hormone-like action binds to nuclear and cytoplasmic receptors to induce the regulation of cellular replication, differentiation, and preprogrammed cell death. For example, without adequate levels of vitamin A, the basal cells of the respiratory and GI tracts differentiate into a squamous epithelium instead of their normal morphology. This is easily observed on choanal gram stains as an immature appearance of the epithelial cells that stain with varying degrees of basophilia.

Carotenoids in the diet serve as vitamin A precursors in chickens and it is assumed that psittacines also use them in a similar manner. Toxicity from vitamin A leads to symptoms that are similar to those observed with a deficiency. Dietary history helps to determine the levels of vitamin A and may help distinguish one symptom from the other on gram stains and by clinical observations.

Vitamin D

Vitamin D activity is found in a group of related sterols including cholecalciferol (vitamin D_3), ergosterol (vitamin D2), and other metabolites. Birds are able to synthesize cholecalciferol from cholesterol but require an adequate amount of sunlight to do so. Because most companion birds do not have sufficient UV exposure for endogenous conversion, they need to have a dietary source of vitamin D. Vitamin D has hormonal actions as it regulates calcium and phosphorus metabolism including bone mineralization and eggshell formation. Vitamin D-deficient hens lay eggs with thin shells and develop osteomalacia with pathologic fractures. Vitamin D toxicity is associated with increased mobilization of calcium with soft tissue mineralization. Recent unpublished data suggest that increased levels of vitamin D can result in renal failure **(**D. Phalen, unpublished data).

CALCIUM

Calcium is necessary for bone mineralization and eggshell calcification, and its ionic form is required for nerve conduction and for myofibril contraction. The calcium requirement for psittacine species has not been determined but the maintenance requirement for chickens is 0.1% of the diet. Many seeds consumed by companion birds are less than 0.03% Ca in the diet, suggesting it is larger than 0.05%.

The calcium requirement in egg-laying chicken hens is 3.3% of the diet, while budgerigars and cockatiels require as little as 0.85% and 0.35%, respectively, for normal calcification. **If you recommend a pelleted diet for these small species**, make sure that the diet is labeled for all life stages to supply adequate levels of calcium and protein for egg laying. Maintenance diets

often do not have adequate levels for chronic egg laying in the smaller psittacine species.

Hypocalcemic Syndrome of African Greys

The pathophysiology of this clinical syndrome is unknown but may result from an inability to mobilize bone acutely. This problem seems less apparent clinically when birds eat at least half of their diet as pellets because vitamin D_3 and calcium are provided. African greys have an uropygial gland and may have a higher requirement or sensitivity for cholecalciferol. For birds, the active form of vitamin D can also be added to a pellet or other balanced food.

Clinical Observation of Calcium Deficiency

Clinical observation of calcium deficiency or decreased bone density occurs when there is too little calcium or vitamin D or too much phosphorus in the diet. This most commonly is associated with egg binding in cockatiels.