

Avian Nutrition Basics

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I. Nutritional strategies

- A. **Faunivores** consume foods almost exclusively of animal origin
 - i. **Carnivores** eat terrestrial vertebrates & **piscivores** eat fish and aquatic invertebrates
 - 1. [Highly expandable esophagus](#)
 - 2. +/- Well-developed crop/ingluvies in some
 - 3. Large high, distensible proventriculus
 - ii. **Insectivores** primarily eat insects
 - 1. Facultative insectivores switch to an insect-based diet during the spring
 - 2. Young, growing granivores
 - 3. Larger, more muscular ventriculus
 - 4. Cuticle or koilin layer
 - 5. Chitinase
- B. **Florivores** consume plant-based foods
 - i. **Granivores**
 - 1. Larger, more muscular ventriculus
 - 2. Pigeons, doves & free-ranging galliforms
 - a. Ingest seeds whole
 - b. Require grit
 - ii. **Herbivores**
 - iii. **Frugivores**
 - iv. **Nectarivores**
 - 1. Soft-bodied insects are consumed to meet amino acid requirements
 - 2. Long, narrow, extensible tongues
 - 3. “Brush tongue” parrots

- C. **Omnivores** are generalist feeders
 - i. Omnivores often shift seasonally between hard and soft food items
 - ii. Example: facultative granivore-insectivores
- D. Psittacine birds are generally classified as florivores (Koutsos 2001)
 - i. Granivores: budgerigars, cockatiels, hyacinth macaws
 - ii. Frugivore: green winged macaws, orange-winged Amazon
 - iii. Frugivore-granivores: blue & gold, military, and scarlet macaws
 - iv. Omnivore: sulfur-crested cockatoos
 - v. Nectarivores: lorikeets and lories

II. **Nutrients**

- A. Components in the diet that provide the energy needed to maintain life **Macronutrients**
- B. **Macronutrients** are large molecules that make up the majority of the diet

i. Water

- 1. Essential for...
 - a. Maintenance of cellular homeostasis
 - b. Epithelial integrity
 - c. Food digestion
 - d. Waste excretion
 - e. Hygiene
 - f. Many metabolic reactions.
- 2. Intake
 - a. Water it drinks
 - b. Water in food items
 - c. Metabolic water.
- 3. Output
 - a. Excreta
 - b. Lungs
 - c. Crop milk
- 4. Requirements are affected by...
 - a. Body size
 - b. Diet type (dry or wet)

- c. Physiological state
- d. Environmental conditions, e.g. humidity and temperature.

ii. Protein

1. Essential amino acids
 - a. Arginine
 - b. Isoleucine
 - c. Leucine
 - d. Lysine
 - e. Methionine
 - f. Phenylalanine
 - g. Valine
 - h. Tryptophan
 - i. Threonine
2. Conditionally essential
 - a. Glycine (budgerigars too)
 - b. Histidine
 - c. Proline
3. Feathers make up the largest part of the protein mass of birds.
 - a. Feathers represent 5.7% of the protein mass in budgerigars
 - b. Feathers are enriched in cysteine and many of the nonessential amino acids,
 - c.

iii. Fat (lipid)

1. Composed of fatty acids and glycerol
2. A complex molecule which serves as a rich storage form of energy.
3. Essential fatty acids
 - a. Linoleic acid, a member of the omega-6 fatty acid family
 - b. Linolenic acid, a member of the [omega-3 fatty acid family](#)
4. Both hyacinth macaws and golden conures require relatively high levels of dietary fat

C. Trace or micronutrients

1. Substances that are only needed in tiny amounts
2. Vitamins
 - a. Fat-soluble vitamins
 - i. Passively absorbed and transported with portomicrons to the liver

ii. Vitamin A

1. Plays a role in:
 - a. Epithelial cell growth and repair maintaining the integrity of respiratory, urinary, and intestinal tracts
 - b. Immune function
 - c. Bone growth
 - d. Vision (night)
2. Beta-carotene
 - a. A dietary carotenoid that serves as a vitamin A precursor
 - b. Incorporated into some pink, red, and yellow feathers (role is not completely understood)
3. Dietary sources
 - a. Animal origin
 - i. Liver
 - ii. Fat
 - iii. Fish liver oils
 - iv. Egg yolk
 - b. Plants and insects are good sources of carotenoids
 - i. Dark, leafy greens
 - ii. Yellow, orange, red, and green vegetables
 - c. Canthaxanthin
 - i. Dietary carotenoid pigment found in green algae, fish, and crustacea
 - ii. Used naturally and commercially in flamingos and other pink or red birds to provide color
4. Deficiency
 - a. Of all vitamins, hypovitaminosis A is most likely to be deficient in both captive and wild birds because the amount consumed in foodstuffs can be extremely variable
 - b. Leads to squamous metaplasia or hyperkeratinization of mucous membranes
 - c. Increased susceptibility to infection
 - d. Impairs the function of the rods in the eye, causing night blindness (reversible if caught early)
5. The signs of vitamin A toxicity in cockatiels are similar to signs of deficiency and typically involve hyperkeratinization of mucous membranes

iii. Vitamin D

1. Regulates calcium absorption from the gastrointestinal tract as well as absorption, mobilization, and deposition of calcium from bone
2. Sources
 - a. Birds are able to synthesize cholecalciferol (vitamin D3) from sterols present in the skin but they require exposure to an adequate amount of sunlight (UVB)
 - b. Dietary sources
3. Deficiency
 - a. Growing birds develop rickets
 - b. Adult birds
 - i. Osteomalacia with pathologic fractures and osteoporosis
 - ii. Thin egg shells, egg production declines
4. Toxicity
 - a. Hypercalcemia
 - b. Mineralization of soft tissues

iv. Vitamin E

1. Only alpha-tocopherols are incorporated into tissues in birds
2. Functions
 - a. Antioxidant activity
 - b. Helps to stabilize and protect cell membranes
 - c. Modulates eicosanoid metabolism
3. Sources
 - a. Alpha-tocopherol levels are highest in green leafy vegetables.
 - b. Other dietary sources include seeds and cereal grains
 - c. Vitamin E originally present in feeder fish can be destroyed prior to feeding since vitamin E is a natural antioxidant
 - d. In formulated feeds, the free form of vitamin E is not very stable
4. Deficiency results in a number of symptoms that relate to cell membrane dysfunctions
 - a. Exudative diathesis
 - b. Muscular dystrophy
 - c. Myopathy of the ventriculus
 - d. Encephalomalacia in chicks

5. Toxicity
 - a. Vitamin E is one of the least toxic vitamins
 - b. However extremely high levels of vitamin E can result in signs associated with deficiencies of the other fat-soluble vitamins
- b. Water-soluble vitamins
 - i. Absorbed by active transport
 - ii. B vitamins are generally required in the diet at regular, frequent intervals
 - b. Serve as co-factors for enzymatic reactions essential to normal metabolism
 - c. Relatively short storage times in the body
 - iii. Vitamin C or ascorbic acid
 - d. Synthesized from glucose within the liver and/or kidney of most birds
 - e. Exceptions: many passerines and one galliform, the willow ptarmigan.
 - f. Vitamin C increases the absorption of dietary iron.
 - g. Signs of vitamin C deficiency have not been documented in pet birds.

3. Minerals

- a. Have functions related to structure of the skeleton, maintenance of body pH, and water balance
- b. **Calcium**
 - a. The mineral required in the largest quantity
 - i. The calcium requirement for altricial species of birds (e.g. budgerigars, cockatiels) is lower than for precocial species (e.g. chicken)
 - ii. Dietary sources include:
 1. Bone
 2. Flaxseed meal
 3. Soluble grit
 4. Soybean meal
 - iii. Ca:P ratio of 1.5 to 2:1 is recommended
 - iv. Deficiency occurs when the diet contains excess phosphorus or when there is too little calcium or vitamin D.
 1. Skeletal deformities, pathologic fractures, rickets particularly in growing birds,
 2. Egg binding, dystocia
 3. Weakness, ataxia, or even tremors and seizure activity.

c. Iodine

- a. Required for thyroid hormone synthesis
- b. Goitrogenic compounds bind iodine making it unavailable for use:
 - i. Cruciferous vegetable
 - ii. Flaxseed
 - iii. Peanuts
 - iv. Peas
 - v. Soybeans
- c. Iodine deficiency leads to goiter
 - i. Seen mainly in budgerigars
 - ii. Due to iodine-deficient water and millet-based seed mixtures
 - iii. Enlargement of the thyroid > secondary compression of trachea and/or crop

III. Energy

- A. Although not a true nutrient, energy is one of the most critical components of the diet
- B. Metabolism of foodstuffs leads to the oxidation of a variety of nutrients, which results in the production of energy
 - i. Nutrients that serve as a major source of energy include CHOs, protein, and fat
 - ii. Fat contains three times more energy than protein or carbohydrate
 - iii. Fat also improves dietary palatability and texture, which increases the danger of overeating and obesity.
- C. Obesity
 - i. A common problem in the pet bird.
 - ii. Species prone to obesity, include galahs, budgerigars, sulfur-crested cockatoos, Amazon parrots, and cockatiels
- D. Basal requirements are needed to maintain basic life function
- E. [Maintenance energy requirements](#) =
 - i. Amount of energy needed to support basal metabolism
 - ii. Plus additional energy to fuel activity
- F. Birds generally eat an amount that satisfies their daily energy expenditure

IV. Life Stages

- A. Growth
 - i. Stage of greatest nutritional stress
 - ii. Chicks require greater amounts of protein, calcium, and energy

- B. Maintenance
 - i. Energy required to maintain body weight in a moderately active, healthy, non-reproducing, non-molting adult in a thermoneutral environment
 - ii. This is the least demanding physiologic state
- C. Reproduction
 - i. The hen's nutritional requirements increase a few days prior to egg production and remain elevated until the clutch or the collection of eggs is laid
 - ii. Associated with increased amino acid and energy needs
- D. Molt
 - i. Also associated with increased amino acid and energy needs

V. Poultry Model

- A. Nutritional requirements are well known in chickens, turkey, Japanese quail, and domestic ducks
- B. National Research Council publishes The Nutrient Requirements of Poultry

VI. Expert Panel on Companion Bird Nutrition

- A. In 1998, the Association of Avian Veterinarians worked with a panel of experts in diverse areas of avian nutrition to develop maintenance guidelines for formulated feed for parrots and songbirds
- B. Available research to date indicates that the nutritional requirements of poultry are similar to psittacine birds a
- C. Energy, protein, and calcium requirements are lower in psittacine birds than in poultry during all life cycle stages.
- D. Companion birds must acquire the same daily quantity of essential nutrients as free-living birds but with much less food consumed.

VII. Foodstuffs Commonly Fed to Companion Birds and they just don't need to expend anywhere as much energy to survive

A. Seeds

i. Oil seeds

1. Rich source of protein, omega-6 fatty acids, vitamin E, and energy
2. Oil seeds are low in calcium
3. Peanuts (aflatoxins)
4. Sunflower seeds
5. Safflower seeds
6. Flax seeds
7. Thistle or niger seeds

ii. Non-oil seeds

1. Relatively low in energy and protein.
2. Millet
3. Canary seed
4. Milo or “grain sorghum”

iii. Domestic seeds

1. More concentrated in energy
2. Lower in certain amino acids, calcium, manganese, zinc, and iron
3. Deficient in vitamins A, D3, E and K, many B vitamins

B. Nectar

- i. Rich in energy
- ii. Nutrient dilute
- iii. Some commercial products contain dangerously high levels of vitamin A

C. Formulated diets

- i. Complete diets are usually based on ground grains and legumes
- ii. Vitamins, minerals, vegetable oil, and purified amino acids are added in appropriate amounts to make up for deficiencies in the grain and protein sources

iii. Pellets

1. Seeds and grains plus vitamins and minerals are finely ground into a powder
2. Dry or steam process under heat (70-80°C)
3. Pressed into a pellet shape lengths
4. Example: Lafeber

iv. Extruded foods

1. Mixture is forced through an extruder under pressure using a dry process or a steam process
2. Higher temperatures (90-180°C)
3. Holes in the plate of the extruder determine the shape of the food.
4. Examples: Harrisons, Kaytee, Zupreem, Hagen, Mazuri

v. Fortified whole seed diets

1. Whole grains and hulled seeds mixed with a pellet base, then coated with vitamins, minerals & amino acids
2. Examples: Lafeber Nutri-Berries and Avi-Cakes

3. [Nutritionally equivalent to pellets](#) but promote foraging
- vi. There are two primary criticisms of formulated diets
 1. Seed-adapted birds are reluctant to switch to formulated diets
 2. The uniformity of formulated diets can be boring to both the owner and the bird
- vii. Nutrient Dilution
 1. Formulated foods should form the basis of the pet bird diet
 2. Formulated diets can be manufactured so that they complement fruits and vegetables that are offered as part of the diet. This is accomplished by increasing the non-energy components of the pellets so that the nutrient dilution created by consumption of fruits and vegetables is corrected.

VIII. [Foraging](#)

- A. The act of searching for, finding, and procuring food
- B. Foraging makes up a significant part of the wild parrot's day
- C. Captive parrots are also behaviorally motivated to forage