

CALCIUM, PHOSPHORUS & VITAMIN D3

IN YOUR BIRD'S DIET

by Carol Highfill

What is a healthy diet for my birds? Are pellets, seeds, and/or other foods the answer? The controversy rages. Knowledge of nutritional requirements for companion birds is still in its infancy, but there is no question that many vitamins and minerals are required to maintain both health and life.

Too much of a nutrient can be as dangerous as too little. Moreover, some nutrients work together to perform vital functions and must be present in the proper ratios to each other. Calcium, Phosphorus and Vitamin D3 are examples of such elements. They not only work together, but too much or too little of one of them can affect the body's ability to use the others. Thus a bird given a diet rich in calcium can show signs of calcium deficiency if the phosphorus or Vitamin D3 levels are not in proper balance. So it is important to understand what each of these nutrients do, how their levels in the body affect each other, what problems are caused by improper levels and how much of each are found in various foods.

What Do Calcium, Phosphorus and Vitamin D3 Do?

Calcium

Comprising about 1.5% of a bird's weight, calcium is the predominant mineral in the body. Calcium is used for bone formation, egg shell production and blood clotting. It also affects the heart, muscles and nerves, as well as some of the body's enzyme systems. Most of the body's calcium is found in the skeleton where it comprises about 1/3 the weight of dried bone. Calcium can also be found in body fluids. Skeletal calcium is comprised mainly of calcium phosphate with some calcium carbonate. Calcium carbonate is the main compound found in egg shells.

The recommended allowance of calcium for a maintenance diet is 0.50%. Higher amounts are required for breeding and growth.

Too little calcium can cause demineralization of bone (fracturing), soft egg shells, and inadequate calcium levels in the blood. Although some birds on all-seed diets can experience hypocalcemic seizures, these seizures are rare except in African Greys. Deficient diets can be supplemented with calcium syrup in the drinking water, sprinkled on seeds or soft foods or administered directly; giving high calcium foods such as bones, cheese or yogurt or sprinkling calcium powder on soft foods. Care must be taken with vitamin supplements not to provide too much calcium.

It has been shown that calcium levels in the diet of over 1% decrease the utilization of proteins, fats, vitamins, phosphorus, magnesium, iron, iodine, zinc and manganese. At a level of 2.5% in the diet nephrosis, hypercalcemia, hypophosphotemia, visceral and renal gout, and decreased food intake have been observed.

Cockatiels are very sensitive to high calcium and high calcium/Vitamin D3 levels. Cockatiels, budgerigars, some grass parakeets and finches live in arid climates and eat mainly lower nutrient, seed diets. They have evolved to conserve nutrients and water and thus they may be more sensitive to high levels of calcium and D3 in their diets. Birds of the neotropics, with access to abundant, varied foods, have not needed to conserve nutrients in their body and may have higher daily dietary needs.

Calcium absorption occurs mainly in the upper intestine and is regulated by Vitamin D3. Some absorption also occurs in the lower intestine. A 2:1 ratio of calcium to available phosphorus in the diet is recommended for maintenance of proper bone tissue. High protein diets and more acid in the intestines appear to aid in calcium absorption. Compounds such as phytates (in cereal grains), oxalates (spinach, rhubarb and related plants) and phosphates reduce absorption of calcium. High fat diets may produce fatty acids in the intestines which can reduce available calcium by forming insoluble calcium soaps. High-fat seeds (eg unsprouted sunflower, safflower) may also impede calcium uptake in the the intestines.

Phosphorus

Phosphorus may affect more biological systems than any other element. It is an important element in many body functions including bone formation, acid-base balance, metabolism of fat and carbohydrates, egg formation and in the proteins, carbohydrates and lipids used throughout the body.

As much as 70% of the phosphorus in the diet may be unusable by a bird. Phosphorus from animal products or inorganic supplements is almost completely usable, but phosphorus from plant sources is considered to have only about 30% availability. Plant sources often contain phosphorus combined with phytin, and animals such as birds lack the enzyme phytase necessary to make the phosphorus available.

The recommended allowance of available phosphorus for a maintenance diet is 0.25% (0.40% total phosphorus). Higher amounts are required for breeding and growth.

Too high levels of phosphorus will interfere with absorption of calcium. A ratio of 2:1 calcium to available phosphorus in the diet plus adequate Vitamin D3 is recommended. Phosphorus is readily available from numerous sources, making inadequate levels in the diet unlikely.

Vitamin D3

Vitamin D3 is essential in regulating absorption and excretion of calcium and phosphorus. This is especially important when the levels (ratios) of calcium and phosphorus in the diet are unbalanced. D3 may also regulate the amount of alkaline phosphatase in the blood and play a role in cell differentiation and immune system regulation.

There are 2 main forms of Vitamin D. Vitamin D2 comes mainly from plants. Vitamin D3 is produced exclusively in a bird's body when sunlight reacts with Vitamin D precursors in the diet. The ultraviolet rays of sunlight or an artificial UV light source transform Vitamin D precursors in the bird's skin to D3. Glass windows filter out the sun's UV rays. Since Vitamin D3 is 30-40 times more potent than D2, plant sources are considered insignificant as a source of Vitamin D for birds. Studies

with poultry show sufficient Vitamin D3 can be produced for growth of chicks with 11-45 minutes of sunshine (not filtered by glass) each day. D3 formed in the skin acts as a hormone in the metabolism of calcium and phosphorus.

The recommended allowance of Vitamin D3 for a maintenance diet is 1000 IU/kg. Higher amounts are required for breeding and growth.

Lack of Vitamin D3 can result in low calcium levels and produces similar symptoms. These include thin or soft shelled eggs, decreased egg production and hatching, and even seizures and bone fractures. In chicks, lack of D3 can result in bent or easily fractured bones. Diseases affecting the liver and kidneys can hinder the bird's ability to produce the enzymes necessary to convert Vitamin D into the D3. At these times, a D3 supplement may be beneficial.

Too much Vitamin D3 (hypervitaminosis D3) can cause calcification, nephrosis and gout. Two studies suggest that high levels of Vitamin D3 in young macaws (especially the blue and gold and the hyacinth) result in crop stasis, enlarged kidneys, gout and other signs. Other species given the same diets showed no effects. Another study showed cockatiels were also sensitive to high Vitamin D3 levels.

At 4-10 times recommended Vitamin D levels, effects can include: increased calcium and bone absorption, hypercalcemia, decreased PTH, mineralization of soft tissues, nephrocalcinosis and polyuria

Balancing Calcium, Phosphorus and Vitamin D3

As mentioned above, a proper bird's diet requires calcium and phosphorus in a ratio of 2 : 1 calcium to *available* phosphorus. Ranges of 0.5 : 1 to 2.5 : 1 can be tolerated by birds. Ratios of 1:1 are required to support adequate growth, 1.5 : 1 to maintain adequate serum calcium, phosphate and alkaline phosphatase values and 2 : 1 to achieve maximum bone density. Egg laying hens will require higher calcium to phosphorus ratios during laying periods.

Vitamin D3 is essential to *regulate and enable* absorption of calcium and phosphorus in the body. This is especially important when the calcium to phosphorus ratios are unbalanced. The D3 will help to regulate the amount of calcium and phosphorus retained in the bird's body. Vitamin D3 levels in the diet should be about 1000 IU/kg.

Pellet manufacturers have incorporated nutrients in their products, making it easier to feed a healthy balanced diet. However, there are variances among brands and concern that pellets have not been tested over time and are not a complete diet. Too much is still unknown about dietary needs. Many owners use pellets as a portion of the diet and supplement with fresh foods, seeds, grains, birdy breads and other supplements. Others avoid pellets entirely, providing a varied and nutritious diet and relying on the body's natural mechanisms to balance the use of the nutrients.

Be sure your bird has an annual exam which can disclose problems. Observe your birds for signs of vitamin and mineral deficiencies and excesses. If you suspect a problem see your vet and discuss changes to the diet.

Food Sources of Calcium, Phosphorus and Vitamin D3

Seeds are usually calcium deficient as can be seen in their calcium/phosphorus ratios. Millet 1 : 6, oats 1 : 8, sunflower seeds 1 : 7. Muscle meat is low in calcium and high in phosphorus 1 : 20.

Sources of Nutrients			
Source: Avian Medicine: The Principles and Application. Based on information from the National Research Council and a Kaytee Technical Bulletin			
Vitamin/ Mineral	Excellent (over 20 times requirement)	Good (over 2 times requirement)	Adequate (1/2-2 times requirement)
Calcium	Calcium carbonate (cuttlebone, eggshell) Bone Meal Dicalcium phosphate	Fish & meat meals Kelp Alfalfa meal Whey	Dried milk Cheese Oil type seeds Most nuts
Phosphorus	Bone Meal Dicalcium phosphate	Fish & meat meals Brewer's yeast Dried whey Wheat Germ Meal Peanuts Pumpkin Seeds Most oil seeds Nuts	Corn Gluten Cereal grains Egg
Vitamin D3	Fish liver oil Liver Fish oil	Eggs (especially yolk)	Dried milk

The Midwest Bird & Exotic Animal Hospital in Westchester, IL has compiled information on a number of foods. The Calcium and Phosphorus contents are for 1 cup of food.

Good Calcium Sources

Food	CA (mg)	P (mg)	Ca:P Ratio
Beet Greens	188	80	1:0.4
Broccoli Leaves	349	89	1:0.26
Broccoli Stem	111	47	1:0.4
Cabbage (outside green leaves)	429	72	1:0.17
Celery	44	32	1:0.7
Chard	300	100	1:0.33
Chinese Cabbage	400	72	1:0.2
Collards (cooked)	14	150	1:0.4

Dandelion Greens	168	70	1:0.4
Endive	104	39	1:0.4
Kale	390	134	1:0.4
Kohlrabi	390	120	1:0.3
Lettuce Dark Green Leaf	25	14	1:0.56
Mustard Greens	582	168	1:0.29
Orange or Tangerine	48	18	1:0.4
Parsley	46	30	1:0.65
Spinach	156	92	1:0.6
Turnip Greens	694	98	1:0.14
Watercress	53	15	1:0.3
Watermelon	33	9	1:0.27
Yellow Wax Beans	63	46	1:0.7

Moderate Calcium Sources

Food	CA (mg)	P (mg)	Ca:P Ratio
Apples	10	10	1:1
Blackberries	43	43	1:1
Blueberries	33	26	1:0.8
Cabbage (inside white leaves)	46	34	1:0.74
Cantaloupe	64	60	1:0.9
Carrots	90	82	1:0.9
Green Beans	55	55	1:1
Guavas	15	15	1:1
Okra	144	124	1:0.86
Pears	15	18	1:1.2
Raspberries	82	76	1:0.93
Rutabaga	99	75	1:0.75
Squash	36	30	1:0.8
Strawberries	68	56	1:0.8
Turnips	112	94	1:0.84
Yams	44	50	1:1

Poor Calcium Sources

Food	CA (mg)	P (mg)	Ca:P Ratio
Apricots	15	21	1:1.4
Asparagus	28	70	1:2.5
Bananas	7	22	1:3.1
Beets	56	84	1:1.5
Broccoli Flowers	85	140	1:1.65
Brussels Sprouts	36	161	1:4.48
Cauliflower	28	46	1:1.6
Cherries (pitted)	19	35	1:1.58
Corn	16	206	1:12.9
Cucumber	10	21	1:2.1

Eggplant	22	62	1:2.8
Grapes	19	35	1:1.8
Lettuce (head, iceberg)	17	40	1:2.4
Mushrooms	19	131	1:6.9
Parsnips	152	152	1:1.3
Peaches	10	19	1:1.9
Peas	56	254	1:4.5
Pineapple	12	12	1:2.9
Plums	20	27	1:1.4
Pumpkin	46	100	1:2.2
Radish	21	29	1:1.4
Sweet Potato	19	45	1:2.4
Tomato	11	29	1:2.6

References: