

Chapter VI

Nutritional Requirements of Adult Palm Cockatoos

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The nutrition section is based on a questionnaire that was distributed in 1992 to facilities that have bred or displayed palm cockatoos, on general knowledge of the nutritional requirements of birds (in particular successful diets and practices with psittacines), and on what has been observed with palm cockatoos at ABRC over the years.

Nutrient requirements.

Psittacines, like other animals and humans, do not require particular food items rather they require specific nutrients; water, amino acids (protein), minerals, vitamins and essential fatty acids. No scientific research has been performed on the nutritional requirements of palm cockatoos, however, numerous nutritional requirement studies have been conducted on precocial birds (chickens, turkeys, geese, ducks, pheasant, bobwhite and Japanese quail). The nutrient requirements for the growth and breeding of precocial birds are listed in Table 1 (NRC, 1984). Research conducted on the nutrient requirements for altricial birds such as cockatoos, has been limited.

Roudybush and Grau (1985) reported that for optimal growth and survival rates of cockatiel chicks the minimal protein and lysine requirement from hatching to 28 days was 20% and 0.8%, respectively. The protein and lysine requirements for precocial birds range from 24 to 31% and 1 to 1.7% of the diet, respectively. It is unlikely that the nutritional requirements differ greatly between precocial birds and psittacines, based on the protein and lysine requirement found in cockatiels and the fact that psittacine chicks gain weight faster than meat-type chickens for several weeks after hatching (Ullrey et al., 1991).

Table 1. Nutrient Requirements for Meat-type Chickens, Turkeys, Geese, Ducks, Pheasants, Bob-white Quails and Japanese Quails

<u>Nutrient</u>	<u>Growth</u>	<u>Breeding</u>
<u>g/kg dry matter</u>		
Protein	240 - 310	160 - 270
Lysine	10.0 - 16.7	5.7 - 12.8
Methionine	5.6 - 5.9	2.2 - 5.0
Linoleic Acid	11.1	11.1
Calcium	7.2 - 13.3	25.0 - 30.6
Phosphorus, available	4.4 - 6.7	2.8 - 6.1
Potassium	4.4 - 7.8	1.7 - 6.7
Sodium	1.7 - 1.9	1.1 - 1.7
Magnesium	0.3 - 0.7	0.6 - 0.7
<u>Nutrient</u>	<u>Growth</u>	<u>Breeding</u>
<u>g/kg dry matter</u>		
Iron	89 - 111	67
Zinc	28 - 83	56 - 72
Copper	7 - 9	7 - 9
Manganese	44 - 100	28 - 78
Selenium	0.16 - 0.22	0.11 - 0.22
<u>Nutrient</u>	<u>Growth</u>	<u>Breeding</u>
<u>IU/kg dry matter</u>		
Vitamin A	1667 - 5555	4444 - 5555
Cholecalciferol	222 - 1333	22 - 1333
Vitamin E	11 - 13	11 - 28

Feeding ecology.

In the wild, psittacines don't just eat seeds, they are limited to what food choices are available, most of which are not replicated in commercial seed mixtures. In captivity they are constrained by our selection of their food which is not a "natural" diet.

In a study of the food habits of the short-billed form of the white-tailed black cockatoo, the cockatoos were reported to eat a total of 30 plant species, mainly flowers and seeds, as well as insect larvae (Ullrey et al., 1991). Eastern and pale-headed rosellas fed on the fruits and seeds of 82 and 47 plant species, respectively, including grasses, forbs, shrubs and trees, and insects (Ullrey et al., 1991). Bahama parrots fed on 16 plant species including the inner portions of green, unopened *Pinus caribaea* cones, stems of woe vine, fruits of wild dilly, poisonwood and naked wood, and the fruit and inner bark of Caribbean pine, fruit or seeds of wild tamarind, jumbay, sea grape, buffalo top palm and silver top palm (Ullrey et al., 1991). Researchers have reported that palm cockatoos have been observed feeding on seed, nuts, fruits, berries and leaf buds. For more details please refer to Chapter I, General Characteristics and Natural History, Section, Diet in the Wild, page 8. The majority of the food items consumed by psittacines in the wild, including the seeds, are not available in seed mixtures sold commercially today.

Manufactured versus seed diets.

Selected seeds found commonly in seed diets sold commercially are nutritionally deficient and do not allow for the optimal growth of psittacines. The nutrients that are deficient include calcium, available phosphorus, sodium, manganese, zinc, iron, vitamins A, D and K, riboflavin, pantothenic acid, available niacin and Vitamin B-12 (Ullrey et al., 1991). Seed diets fed for reproducing birds probably also are deficient in calcium, available phosphorus, sodium, manganese, zinc, iron, iodine, selenium, vitamins A, D, E and K, riboflavin, pantothenic acid, available niacin, vitamin B-12 and choline (Ullrey et al., 1991). Seeds generally have a high crude fat content (40.7%, 49.2%, 52.4% and 52.7% for safflower seeds, pumpkin seeds, sunflower seeds and peanuts, respectively) which can lead to obesity (Ullrey et al., 1991) and are also likely deficient in many of the essential amino acids, most notably lysine (Brue, 1990). A typical cockatiel seed diet contains 0.45% lysine while the requirement for growth and maintenance of precocial birds ranges from 1.0 to 1.6 % and 0.57 to 1.3% respectively (Brue, 1990).

Manufacturers of seed diets realize the inadequacy of seeds and attempt to overcome the deficiencies in seed diets in a variety of ways including adding manufactured diets (extruded or pelleted diets) to the seed mixture and/or coating the hulls of the seed with vitamin and mineral solutions. However, since seeds are more palatable, the birds tend not to eat the pellets when provided with the seed mixture. Rather they tend to select the seeds that are higher in fat, lower in protein and lower in calcium. Additionally, in diets where seeds are coated with vitamins and minerals, there may be a loss of vitamins and minerals as a result of birds removing the hulls of the seeds.

In a mixed diet birds can select their favorite items. This can lead to a nutritional deficiency. For example, a rachitic 8-wk-old Timneh African gray parrot was reported by Ullrey et al. (1991) as a result of being fed primarily corn from a seed mix supplied by the parents. Hypocalcemic tetany was found in a 4 year-old female green-cheeked amazon parrot fed a diet consisting solely of corn and peanuts for 4 years (Randell, 1981). Radiography revealed poor bone quality and a fracture of the left femur. Corn and

peanuts both have calcium to phosphorus ratio of approximately 1:7 well above the optimal dietary level of 1:1 to 2:1 (Randell, 1981). Tetanic seizures were also observed in a female red-sided eclectus parrot, a female yellow-tailed black cockatoo and a male Caribbean parakeet which were fed diets consisting of sunflower seeds, peanuts and whole oats (Wallach & Flieg, 1967). Osteomalacia was found on necropsy.

Feeding manufactured diets eliminates the potential selection of a seed with a particular nutrient profile. Rather the birds consume a diet with a nutrient profile designed to meet the nutrient requirement of psittacines. While a manufactured diet should provide the bulk of the nutrition, most manufactured diets are formulated to allow for supplementation of fruits and vegetables, which are a valuable source of nutrients, and a limited amount of seed and nuts to provide variety in the diet or for training purposes. Several companies manufacture diets for psittacines (See Appendix 2, Manufacturers List). It is important to select a brand from a reputable manufacturer that has a good quality control program and has tested its product with breeding facilities. Since products may differ in nutrient content and other food items are typically added to the diet, care must be taken to select a product that will provide adequate nutrient concentrations when those nutrient concentrations are diluted due to the other food items. Transition from seed diets to manufactured (pelleted or extruded) diets must be done slowly and carefully to allow acceptance and thus adequate consumption of the diet.

Dietary intake studies with psittacines.

Three adult Timneh African grey parrots were offered a mixture of an extruded diet, seed, fruit and vegetables (Ullrey et al., 1991). Because the birds could sort through their diet, seed consumption predominated resulting in diets that were marginal or deficient in the following nutrients; methionine, calcium, available phosphorus, sodium, manganese, zinc, riboflavin, vitamin B-12, available niacin, pantothenic acid, vitamin A and Vitamin D.

In another study (Ullrey et al., 1991), seeds were gradually withdrawn from a diet which consisted of an extruded diet, fruits and vegetables which was fed to green-winged macaws, yellow-headed amazons, citron-crested cockatoos, Ambonia king parrots and northern rosellas. One pair of each species was housed together and consumption of a seed free diet was measured for one week. The consumption of the extruded diet was less variable than when fed with seeds and the consumption of the other items did not produce a nutritional imbalance. Substitution of an extruded diet for the seeds did not change the number of chicks hatched per year but it did increase the fledgling percentage.

Howard et al., 1992, reported on the dietary husbandry of psittacines housed in a commercial aviary. A dietary program, which consisted of an extruded diet (Table 2), fruits and vegetables, was tested at two different seasons for its ability to support maintenance and reproduction in adult psittacines at a commercial aviary. The species studied were African gray parrots, yellow-naped amazon parrots, double yellow-headed amazon parrots, blue & gold macaws, green-winged macaws, medium sulfur-crested cockatoos, salmon-crested cockatoos and umbrella cockatoos. All nutrients were

consumed in amounts sufficient to meet the needs of precocial birds and presumably were adequate for psittacines as well. At the time of the preparation of the manuscript seven proven pairs of psittacines had produced 107 eggs. Of those 80.4% were fertile, 16.8% were infertile, 2.8% were broken prior to knowledge of the fertility. Of the 86 fertile eggs produced, one egg was broken (1 %), one chick died (1%) and 84 birds were hatched (98%) and successfully reared to weaning.

Table 2. Nutrient specifications for a manufactured diet¹

<u>Nutrient</u>	<u>Concentration</u>	
	<u>g/kg dry matter</u>	<u>%</u>
Protein	240.0	24.00
Lysine	12.0	1.20
Methionine	5.0	0.50
Linoleic Acid	20.0	2.00
Calcium	11.0	1.10
Phosphorus, available	8.0	0.80
Potassium	7.0	0.70
Sodium	2.0	0.20
Magnesium	1.5	0.15

<u>Nutrient</u>	<u>Concentration</u>	
	<u>mg/kg dry matter</u>	<u>%</u>
Iron	150	0.015
Zinc	120	0.012
Copper	20	0.002
Manganese	65	0.0065
Selenium	0.3	0.00003

<u>Nutrient</u>	<u>Concentration</u>
	<u>IU/kg dry matter</u>
Vitamin A	8000
Cholecalciferol	1900
Vitamin E	250

The previously mentioned studies demonstrate that the incorporation of manufactured diets into the diets of psittacines, including citron-crested cockatoos, medium sulfur-crested cockatoos, salmon-crested cockatoos and umbrella cockatoos, can be very

successful for the maintenance and reproduction of these birds. Thus it is reasonable to assume that the use of manufactured diets for palm cockatoos will be successful as well.

Captive diets of Palm Cockatoos.

Diets Used

Palm cockatoos tend to be lean birds and obesity has not been observed. These birds have been successfully maintained on seed mixes consisting mainly of sunflower seeds and other additives like whole corn, dog kibble, dried red peppers and other seeds and grains. Many facilities also offer manufactured monkey biscuits. It is evident that holders of palm cockatoos understand the need for a nutritionally complete manufactured product in the diet. Until the past few years the only products available were primate biscuits and dog food. Although, palm cockatoos have been successfully maintained on primarily seed mixes with additives, the use of manufactured diets (pelleted or extruded) eliminate the need for nutritionally deficient seeds as the primary diet. Additionally, reliance on dog and primate foods can be decreased because they may be more variable in nutrient composition and not formulated specifically for psittacines. It is also possible that growth, reproduction and longevity may improve with better nutrition. Several companies manufacture diets of various shapes and sizes, which may help to increase the consumption of these diets (See Appendix 2, Manufacturers List; See also Section Practical Diets for examples of diets being used by institutions breeding palm cockatoos). Caution should be taken when converting birds from seed diets to manufactured diets to ensure adequate consumption of the diet. Parameters to monitor when converting the birds include food intake measurements and body weight fluctuations. It should be noted that food intake measurements must account for all food wasted such as seed hulls and chaff.

Supplements

Many varieties of nuts can be given in addition to a basic diet of manufactured diets: pine (pinyon) nuts, almonds, peanuts, coconuts, hazel nuts, walnuts, macadamia nuts, pandanus, pecans, and fruit from the queen palm (*Syagrus romanzoffianum*). Nuts should always be offered in limited amounts either daily or occasionally to ensure adequate consumption of the manufactured diet. Fruits and vegetables also can be offered daily. Apples, oranges, broccoli, corn, yams, carrots, beets, bananas, pomegranates, grapes, beans (all types), different kinds of leafy greens, and celery are some examples. Although the availability of fruits and vegetables fluctuates seasonally, a variety can be fed daily; the amount needs to be controlled to ensure consumption of the nutritionally complete manufactured diets. A good strategy and one which compliments the feeding ecology of the birds is to allow free access to the manufactured diet (this allows the bird to consume

food at anytime it pleases and decreases competition between or among birds) while providing the additional items once or twice per day. The manufactured formulation of the diet and its nutrients should be periodically checked as any changes made by the manufacturer may affect the nutrient status of the birds.

Generic multi-vitamin/mineral/amino acid supplements are not necessary if the birds consume an adequate amount of a nutritionally complete manufactured diet. However if the birds obtain no manufactured diet or if they are sick, adding a supplement may be warranted. A variety of additives are available on the market today. Again, if a manufactured diet is used it should eliminate the need for a multi-vitamin/mineral/amino acid supplement as the manufactured diet should supply a proper balance of these nutrients when intake is good and the other items are limited. Adding supplements to the diet indiscriminately could potentially lead to an imbalance of nutrients or to a toxicity of nutrients. Cuttle bone, which is 85 % calcium carbonate (calcium carbonate is 40% calcium), is a favorite of palm cockatoos at ABRC when consuming diets with little manufactured diets. But again, this potent source of calcium is not needed if the manufactured diet is appropriately formulated and is consumed by the birds.

Practical Diets

A manufactured diet formulated for psittacines, Kaytee Rainbow chunky breeder pellets, has been used at ABRC since the beginning of 1997 and may prove appropriate for the reproduction, health and well being of palm cockatoos.

ARBC palm cockatoo diet, percent contribution to total diet by weight, as fed

1.0 % Nuts: Peanuts, brazil nuts, hazel nuts

16.5 % Fruit and Vegetables: Oranges, apples, grapes, sweet potatoes, carrots, beets, broccoli, kale

16.5 % Pine Nuts

33.0 % Seed Mixture: Sunflower seeds (70%), nutritionally complete manufactured diet (15%), dehydrated whole corn (10%), cuttlebone (5%)

33.0 % Nutritionally Complete Manufactured Diet containing: 18.0 % Crude Protein
Kaytee Rainbow chunky breeder pellets 7.0 % Crude Fat

12.0 % Moisture

6.0 % Ash

5.0 % Crude Fiber

The manufactured diet is usually provided in one bowl and the other items in another. If changing diets, be sure to monitor consumption because palm cockatoos as well as other psittacines are known to be finicky and may not adjust to new diet changes readily. As the following examples show, there are several manufactured diets currently being fed to palm cockatoos. These diets are from a few of the institutions which have breeding pairs.

Denver Zoo

Palm cockatoo diet (pair)

1/3 cup sunflower seed mix
3/4 cup safflower seed mix
1/2 cup Scenic Jungle pellets
1/2 cup chopped asst fruits
1/4 pomegranate
2 Purina monkey chow biscuits
1 tbsp pinion nuts when in season
mixed nuts

Sea World of Florida

We feed the adults two pans - morning has an array of available fresh fruits and vegetable and a couple of Zupreem monkey chow biscuits and in the late afternoon Mazuri diet and a couple of nuts (Brazil, almond or peanut).

Riverbanks Zoo

Zupreem pellets 75%
Produce & seeds 25%
Necton MSA sprinkled over diet. (Mineral/vit. supplement)

White Oak Conservation Center

1 cup Kaytee breeder
1 cup chopped assorted fruits/vegetables - bananas, apples, oranges, grapes, corn, greens, carrots
1 tsp petamine (vitamine/mineral supplement)
5-6 large nuts given three times per week - walnut, Brazil nut, hazil nut, kamani nut, almond
1 tbsp pinion nuts given three times per week

Feeding Schedule

The majority of the institutions responding to the survey fed only once a day, in the morning. A few institutions indicated they fed twice a day, once in the morning and again in the evening. Fresh, clean water should be offered daily. Fruits and vegetables should be removed from the cage at the end of the day to prevent potential spoilage and bacterial contamination.

It is possible that palm cockatoos in the wild consume food sporadically throughout the daylight hours. In keeping with the birds natural feeding schedule, the manufactured diet should be made available at all times throughout the daylight hours. ABRC provides food so that the birds can eat throughout the day.