

presence in the mix. Because seeds are commonly relished more than pellets, sufficient amounts of supplements are seldom consumed.

Complete Pelleted or Extruded Diets

The success of complete, mixed diets for chickens, turkeys, and game birds has led to the formulation of such diets for psittacines. Ingredients, that in whole form might be differentially selected, can be ground and mixed together with minerals, vitamins, and other supplements to provide needed nutrients plus pigments that impart the brilliant colors characteristic of healthy psittacines. Since ground, meal-type diets are not relished, pellets or extrusions are produced. Psittacines have a tactile bill-tip organ that assists them in the identification, selection, and manipulation of food. Extrusions, in particular, seem to be favored by psittacines.

Pellets are manufactured by adding steam to a mixture of dry, ground ingredients and forcing this mixture through the holes in the circumference of a ring-shaped die. Extrusions are manufactured by forcing a thick mixture of dry, ground ingredients and water through holes in the face of a plate-shaped die under high pressure and temperature. This mixture expands on contact with the air into a morsel that may float on water. Both pellets and extrusions are dried for safe storage without molding. Nutrients that are temperature sensitive are added in excess to ensure required levels are met in the final product.

Nutrient Requirements

Research conducted on the nutrient requirements of psittacines indicates that nutrient needs are comparable to those established by the National Research Council/National Academy of Sciences for domestic poultry. There is, however, an important distinction between newly hatched chicks that can feed themselves and psittacine babies that require care. When parent-reared, psittacine babies are fed regurgitated food by their parents. Thus, food offered to their parents must be of a quality appropriate to meet nutrient needs of the young, even though parental needs may be less.

There are no government standards for psittacine diets, but the nutrient concentrations shown in Table 1 have successfully supported maintenance, growth, reproduction, and health when fed as an extrusion, alone or with fruits and vegetables, in controlled studies. When the extrusion was fed with fruits and vegetables, it furnished 80 to 94% of dry diet intake. Because the fruits and vegetables were good sources of nutrients and furnished no more than 20% of total dietary dry matter, they did not significantly change the nutrient balance of the extrusion.

There is no fool-proof way to identify commercial products that are suitable for psittacines based on legally required label information. Pet owners should look for information indicating that nutrient specifications are met. Ask your veterinarian for more information on identifying a suitable product.

Feeding Other Foods

Bird owners who are inclined to offer food items to their pets in addition to complete pelleted or extruded diets may change the nutrient balance by doing so. This is potentially most serious when the additional items are seeds and nuts. As noted previously, psittacines often choose seeds or nuts over pellets or extrusions when offered a choice. There is less danger of upsetting nutrient balance when the additional items are fruits and vegetables. The main reasons for this are that items such as green beans, celery, carrots, and spinach are each good sources of many nutrients, and they also are high in water (88 to 94%). Thus, even though they may make up a high proportion of dietary wet weight, they have a relatively small influence on the balance of nutrients supplied by dry pellets or extrusions that are only 5 to 13% water.

Changing the Diet

Changing psittacines from a seed diet to a complete pelleted or extruded diet requires patience and care. Increasing amounts of the new diet are gradually introduced over a several days, whereas amounts of the old seed diet are gradually reduced. The birds should be closely watched (specially when in groups or pairs) to make sure the new diet is being eaten in sufficient amounts to meet needs. Socially dominant

birds will limit access of other birds to preferred foods, and types and amounts of food consumed may differ among birds of different social status. Most birds will make the transfer within a few days. Any bird that refuses to eat any of the new diet should be temporarily returned to the old diet. Another attempt at changing the diet may be made a few days later.

TABLE 1	
Nutrient	Concentration**
Protein, %	22
Arginine, %	1.2
Isoleucine, %	1.0
Lysine, %	1.1
Methionine, %	0.45
Methionine + cystine, %	0.8
Threonine, %	0.9
Tryptophan, %	0.22
Linoleic acid, %	1.8
Calcium, %	1.0
Total phosphorus, %	0.75
Available phosphorus, %	0.55
Potassium, %	0.65
Sodium, %	0.2
Chlorine, %	0.2
Magnesium, %	0.15
Iron, mg/kg	135
Copper, mg/kg	18
Manganese, mg/kg	65
Zinc, mg/kg	120
Iodine, mg/kg	1
Selenium, mg/kg	0.3
Vitamin A, IU/kg	8,000
Vitamin D ₃ , IU/kg	1,800
Vitamin E, IU/kg	250
Vitamin K ₁ , mg/kg	4
Thiamin, mg/kg	6
Riboflavin, mg/kg	6
Pantothenic acid, mg/kg	20
Niacin, mg/kg	55
Pyridoxine, mg/kg	6
Folacin, mg/kg	0.9

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Biotin, mg/kg	0.3
Vitamin B ₁₂ , mg/kg	0.025
Choline, mg/kg	1,600

* Supported maintenance, growth, reproduction, and health in 17 species of psittacines when fed alone or with fruits and vegetables

**Concentration in air-dry food (10% moisture). To convert to concentration in dry matter, divide values by 0.90.

Feeding the Adult Bird

A good quality pellet or extrusion can be fed free-choice. Fresh water also should be provided. Food and water should be changed often enough to keep them fresh. If high-moisture foods, such as fruits and vegetable, are offered as well, refused and soiled food should be removed daily.

Handfeeding Babies

A good quality, handfeeding diet should be freshly prepared and fed according to the manufacture's recommendations. Such diets are commonly marketed as finely ground powders. Initially, about three parts of warm water are added to one part of dry powder in a blender to produce a homogenous slurry. The temperature of the slurry should be about 100 to 105 degrees Fahrenheit when fed. If necessary to heat a large amount of slurry, use of a double-boiler with stirring is recommended. A microwave is convenient, but extreme care must be taken to ensure that heat is evenly distributed and not excessive when the slurry is fed because of the danger of hot spots and harm to the lining of the oral cavity, esophagus, and crop. Newly-hatched birds are commonly fed with a syringe (without a needle), starting 6 to 12 hours post-hatching (after the first elimination of waste). They are fed about every 2 hours until midnight. Feeding resumes on a 2-hour schedule at 6 a.m. Gradually, the proportion of dry matter to water is increased, and the time between feeding is extended. By 4 to 6 weeks, many young birds will show interest in solid food. Morsels of a complete extruded diet can be moistened with warm water and offered by hand. As consumption of solid food increases, slurry feeding can be reduced. Ultimately, the birds can be weaned to a dry extruded diet plus water. For those who have not previously hand-raised baby psittacines, it is good to observe the methods of an experienced aviculturist.

Diet and Gout

Because adult, nonbreeding psittacines probably have lower requirements for well-balanced protein than do young or breeding psittacines, some pet owners worry that feeding protein in excess of need will cause gout. Gout is an accumulation of uric acid and urates in joints or soft tissues in amounts which cause functional damage. Uric acid is the main end product of nitrogen (protein) metabolism in the bird. It is produced in the liver and kidney and is excreted via the urine. The nitrogen in uric acid may come from protein in the diet or from the breakdown of protein in body tissues.

In studies of breeding parakeets fed complete diets containing 13.5, 18.2, or 26.3% protein or a vitamin- and mineral-supplemented-seed diet, breeders on the supplemented-seed diet had higher plasma uric acid concentrations at 35 days post-hatching than did breeders fed any of the three complete diets. Plasma uric acid concentrations at 21 days post-hatching were not different among chicks' parents had been fed the supplemented-seed diet as compared to those whose parents were fed the two lower-protein complete diets. It is likely that this effect was a consequence of inadequate amounts of protein in the seed diet or of the lysine deficiency that is so characteristic of many cultivated seeds.

Plasma uric acid may be elevated in birds that occupy socially subordinate positions and are kept from food or water by aggressively dominant cage mates. related factors include infections or nutrient deficiencies that inhibit food or water consumption, and certain drugs, such as furosemide, ethacrynic acid and chlorothiazide, or vitamin A deficiency that interfere with uric acid excretions. Even the time that a blood

sample is taken relative to the time of eating will alter plasma uric acid concentrations two- to threefold. In summary, a well-balanced diet is least likely to adversely affect uric acid metabolism, and moderate amounts of high quality protein pose no threat of gout to the normal bird. Considering the common practice of offering foods in addition to pellets or extrusion, use a well-fortified pellet or extrusion as the main food ensure that nutrient needs of all classes of psittacines will be met.

Glossary

Cultivated seeds - seeds produced by commercial agriculture

Extrusions - food morsels produced by mixing ground ingredients with supplements and water and forcing mixture through a die under high pressure, followed by drying; heat and pressure kills microorganisms and partially digests starch

Gout - an accumulation of uric acid and urates in joints or soft tissues

Psittacines - parrots and relatives

Slurry - finely ground diet powders blended with warm water (to make bird "baby food")

Supplements - added to diet ingredients to affect intake of nutrients or other materials

Uric acid - the principal end product of nitrogen (protein) metabolism in the bird

Review

Over 9,000 living bird species have been identified, and their natural diets are as diverse as their habitats. Those kept as pets are commonly considered seed eaters, but studies of these birds in the wild have revealed that their natural foods are very different from the commercial seed mixtures so frequently offered.

This difference in composition from natural foods affects nutrient consumption and can be very important. Caged psittacines offered cultivated seeds as their main food have not coevolved with their food supply, and seed choices of captive birds are often inappropriate. The consequence may be poor muscle development, obesity, impaired reproduction, and specific signs of nutrient deficiency, such as deformed and broken bones.

Additionally, nutrient content of a seed mixture as sold may be very different from what is consumed.

There are no government standards for psittacine diets, but the nutrient concentrations shown in Table 1 have successfully supported maintenance, growth, reproduction and health when fed as an extrusion, alone or with fruits and vegetables, in controlled studies with 17 species of psittacines.