Abstract

In the absence of a staff nutritionist, the task of overseeing a zoological nutrition program often falls to the veterinarian. Exotic avian nutritional requirements have yet to be determined across all taxa. Given the diversity of an avian collection, the most up-to-date veterinarian can spend an inordinate amount of time trying to develop a nutrition program. Time may be better spent devoted to veterinary medicine.

Diets at the Houston Zoo had evolved over time with good intentions but with little basis on science. In order to provide the best nutritional program, it is necessary to systematically collect data on existing diets and seek professional help in the analysis of diets fed in the past and proposed improved diets. We discovered that waste and overfeeding was more significant than initially expected and that time saving protocols could work without affecting the health of the animals.

No single member of the staff had all the answers and, a team approach, utilizing the expertise of curator, keeper, veterinarian, and consultants resulted in a successful program with mutual understanding and compliance.

Introduction

The Houston Zoo bird collection consists of approximately 900 specimens of 225 species. The collection specializes in four main family groups turacos, corvids, curassows, pigeons and doves. These four groups have been maintained and bred consistently over the past 20 yr. Sixteen forms of turaco and 10 species of corvid have been successfully raised. It would not be unusual to have 70-80 specimens of turaco and 25-30 corvids housed at the zoo at the same time.

Few changes had occurred in diets over the years, Though successful in many ways, dietary inadequacies had resulted in medical problems as well as problems in preparation time, presentation and waste. The goal of the diet review was to improve nutrition, simplify ingredients and eliminate costly waste. But more important was the need to determine the nutritional value of successful diets, fed over many years, and developed from trial and error not necessarily from sound science.

This paper emphasizes the need for a combination of expertise and collaboration in the art and science of avian husbandry.

Methods

Mazuri/Purina Feeds assisted the Houston Zoo in developing diets for their collection. An avian nutritionist from Purina and Houston's staff veterinarian oversaw the process. The following steps are meant to be a guideline, each facility will undoubtedly vary.
Steps to Follow

Data Collection

Have staff at all levels "buy-in" and get involved with the process!

Designate a keeper liaison to help collect and disseminate information. Let keepers design the form to be used for data collection, it will save you many re-writes if their input is sought from the beginning.

Insure that staff at all levels understand basic avian nutrition!

This may require extra efforts and several presentations but will pay off in the long run if everyone is on the same track and understands the vocabulary.

Determine what is being fed, not what is written on the diet cards but exactly what each keeper is putting on the plates (live foods, treats, vitamin supplementations and the basic diet). It will be necessary to provide several digital scales and several sets of the same spoons, cups and other measuring devices. Be sure accurate measurements are being taken and everyone is using the same conversion methods.

Calculate the waste. Carefully weigh food left at the end of the day and identify preferred items. Ask about rodent, insect and other feral pests and determine amounts of food consumed by them.

Ingredient Database

Once the data collection (diet ingredients and amounts) were provided by the zoo personnel, it was found that the nutrient data set available was not very complete with respect to key ingredients (anoles, mealworms, crickets, specific commercial diets, mouse pups, etc.) used at the zoo. An extensive analysis of certain ingredients was done for moisture, protein, fat, fiber, macro- and micro-minerals, and fat and water soluble vitamins. These values were added to the data set of the formulation programs being used (The Animal Nutritionist, N-Squared Computing & Durango Software, 1985, Silverton, OR 97381USA).

Diet Nutrient Requirements and New Diet Recommendations

The diet ingredients (items) and amounts supplied by the zoo were inputted into the formulation program (The Animal Nutritionist) and a nutrient content profile was obtained for the diet being used (original diet). Diet nutrient content was compared to a developed standard (recommended nutrient levels), potential problem areas were identified (deficiencies, excesses, and imbalances), and a new diet recommendation was provided to the zoo. The diet recommendations given were designed to use items available at the zoo with known palatability to the birds, to simplify the diet, to minimize the possibility of error, and to meet the developed nutritional recommendations. The diets were fine-tuned and reevaluated 1.5 yr after the initial recommendations were given. Reevaluation was based on a review of palatability, breeding performance, health problems, overall physical condition of the birds and chick survivability (this included parent reared birds as well as the utilization of the basic diet as a hand rearing diet). The reevaluation processes should be considered ongoing. A true test of the new diet
will not be complete until the birds experience the seasonal challenges of breeding, laying eggs, raising chicks and also growing older.

Development of the Recommended Nutrient Levels

Limited information is available on nutrient requirements for avian species not under intensive commercial production. Given that no nutrient recommendations exist for the avian species being reviewed, recommended nutrient levels had to be developed to use as a reference point when reviewing diets.

In developing the nutrient recommendations several factors were considered:

- feeding habits in the wild;
- behavioral differences such as corvid species that wash their food before ingestion;
- known nutritional idiosyncrasies (e.g., the magenta wing colors in turacos result from a red pigment, turacin, which is copper based);
- where available, nutrient content of diets that have been successfully used;
- the baseline used was the National Research Council’s Nutrient Requirements of Poultry, and
- where available, general nutrition information available in the scientific literature, mainly in relation to pheasants, quail, pigeons, parrots, finches, flamingos and cranes.

Breeding and maintenance recommendations were developed and named. Diets were assigned on the basis of feed preferences (with some exceptions) as follows:

- nectar-eating birds;
- fruit-eating birds;
- fruit, vegetable, and seed-eating birds;
- seed and vegetable-eating birds;
- insect, fruit, and vegetable-eating birds;
- meat, insect, and fruit-eating birds;
- meat and insect-eating birds; and
- psittacines.

Results

The original diets reviewed contained approximately 80 different items. In most cases the ingredients used were included because they had traditionally been used, but the reason for inclusion in the diet was not evident. Several vitamin and mineral supplements were used in amounts described as "a pinch". "A pinch" was weighed in the different feed preparation areas and within the same feed preparation area over a period of 3 days. "A pinch" was found to weigh between 0.1 and 1.9 g, with differences existing within the same feed preparation area and between feed preparation areas. This lead to large nutrient variations leading in some cases to excesses and in others to deficiencies. Given the large number of items used, the high degree of variation between areas and with areas, the high probability of error given the system being used, the high level of wastage (estimated at 40 to 50%), it was important to develop diet recommendations that would address these problems. The number of items used
was reduced by approximately 60%. All vitamin and mineral supplement were eliminated from the diets and wastage was reduced to less than 10%.

Concerns with acceptability of the diets that were initially recommended lead to some changes in the ingredients used and in the preparation of the diets. Ingredient mixing was implemented to increase consumption of the extruded diets and to discourage poaching by feral birds (mainly sparrows). For example Bird of Prey Diet (Animal Spectrum Inc. North Platte, NE) and Parrot Breeder 56A9 Mazuri, St. Louis, MO were rolled together in a ball and offered as a mix, in other cases the chopped fruit mix and Parrot Breeder 56A9 (soaked or dry) were also mixed together.

For the purpose of this paper, and due to space limitations two species will be discussed, Beechey's jays (Cissilopha beecheii) and red-crested turacos (Tauraco erythrolophus).

The original Beechey's jay diet was made up of 17 items and varied considerably between exhibits and keepers. When the nutrient content of one of these sample diets was reviewed (on a dry matter basis) the following issues were of concern: very high vitamin A (42.6 IU/g), and vitamin D$_3$ (7.8 IU/g); low choline (786 ppm), manganese (33 ppm), selenium (0.09 ppm). Also, a vitamin supplement was being sprinkled in a "pinch" amount and this amount varied considerably.

The jays were very preferential in their consumption, choosing mostly the meat and insects. Thus much of the diet went to waste. Though breeding well with good egg production, chick mortality was high and cataracts were occasionally seen in young adult jays.

The initial diet recommendation for the Beechey's jays was a diet based on 5 items (Bird of Prey Diet, mouse pups, fruit mix (25% apple, 25% papaya, 25% cooked sweet potato, 25% grapes and soaked raisins) a chopped greens mix (equal parts of endive, kale, and Mazuri Parrot Breeder 56A9. This recommendation was modified over time to comprise rotational items such as crickets, mealworms, and an in season rotational fruit or vegetable. This last modification resulted in a 7 item diet that closely matched the recommended nutrient levels for meat, insect, and fruit-eating birds and that the birds ate well. By rolling small meatballs of Bird of Prey Diet in crushed Parrot pellets the birds were forced to consume some of the pelleted food. No further cases of cataracts have been observed and chick survivability has increased.

The original red-crested turaco diet contained 13 items and also had a vitamin supplement in powder form that was being sprinkled over the feed. Large variations in powder supplement levels were observed and this lead to nutrient content variations. From a nutrient content perspective (on a dry matter basis) the diet was low in vitamin E (30.9 IU/kg), choline (790 ppm), biotin (0.1 ppm), zinc (51 ppm), copper (8.6 ppm), manganese (34 ppm), methionine (0.26%), and total sulfur amino acids (0.44%).

Turacos are primarily fruit eaters and will clean all fruit from an offered diet shortly after presentation. Keepers often overfeed the fruit component of a diet in their efforts to make sure the birds do not "go hungry" and sometimes overlook the protein portion of the diet contained in the commercial pellet. Though birds were breeding well often chicks would hatch with apparent calcium deficiencies (fractured and/or soft bones).
Other nutrient deficiencies were manifested in "washed-out" coloration in juvenile plumages.

The breeding diet was modified to a four-item diet (mealworms, greens and fruit mix, and Mazuri Parrot Breeder 56A9) with no added supplements. To prevent poaching in certain exhibits where the enclosure wire allows sparrows access to the feed, the parrot breeder was ground and mixed with the fruit mix. The recommended diet nutrient levels were similar to those in the nutrient recommendations developed for vegetable, fruit, and seed-eating birds and contained 23.3 ppm copper.

Since incorporating the new diets, together with increased keeper awareness of avian nutrition, we have seen a marked decrease in the two observable deficiencies previously mentioned.

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LITERATURE CITED

