KORI BUSTARD NUTRITION AND DIETARY HUSBANDRY

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Abstract

Kori bustards (*Ardeotis kori*) are reported to be omnivorous, consuming mostly insect and plant material in their grassland habitat. A complete nutrient analysis of these food items and their contribution to the overall diet has not been determined. The gastrointestinal tract of the kori is typical of an insectivorous bird, but to date they have been fed in captivity as "primarily carnivorous" omnivores. Based on free-ranging ecology and gastrointestinal morphology, the recommended diet is based on nutritionally complete feeds, whole prey (vertebrate and invertebrate), and produce. Recommended crude protein in diets offered to captive koris should range between 16.5-30.0% on dry matter basis. When handrearing kori chicks, diets should contain between 18-22% crude protein on a dry matter basis and growth should not exceed 5% of body weight per day, in an attempt to avoid "angelwing."

Introduction

Kori bustards (*Ardeotis kori*) are reported to be omnivorous. Studies have shown that they consume mostly insects, but also plant material such as leaves, seeds, gums, and flowers in their grassland habitat.[2,8,10] The kori bustard gastrointestinal tract is typical of an insectivorous bird.[6] The esophagus is not as pronounced as that of a carnivorous bird and the ventriculus is thick and muscular (a trait characteristic of birds consuming complex food items such as insects and plant material).[5,12] Additionally, koris have a pronounced cecum, which is common in herbivorous and omnivorous birds such as ostriches, rheas, cranes, and quail.[5] Despite observations of free-ranging foraging ecology and gastrointestinal morphology, these birds have been fed as primarily carnivorous omnivores in captivity.

Few data are available regarding successful hand-rearing of kori bustard chicks.[7] All reported hand-reared chicks prior to 2003 have developed angel wing. In 2003, consumption data was recorded by weight for two hand-reared chicks. One chick developed lateral (outward) rotation of the distal carpometacarpus ("angel wing") and one chick did not.

Nutrient Guidelines

Target nutrient levels established for koris were derived from several domestic and non-domestic species (pheasants, quail, geese, and cranes).[1,9] In cases where these target values are expressed as ranges, the low end represents a maintenance requirement and the high end (marked by a double asterisk, Table 1) represents a breeding requirement (with the growth requirement tending towards the high end of the range).

Of special note, the proposed nutrient guidelines for crude protein include a range from 16.5 – 30.0% on a dry matter basis. Available data indicates that breeding diets for koris that contain

26.4% crude protein on a dry matter basis should be adequate.[3] Work with Sandhill cranes recommends dietary crude protein levels of no more than 24% on a dry matter basis for growing birds,[11] which also may be appropriate for growing koris. All of these crude protein values are considerably lower than those of currently offered koris.

Zoo Diets

The nutritionally complete items included in the diet should provide the nutrient backbone of the diet. Whereas specific nutritionally complete feeds are not recommended, specifications for an appropriate nutritionally complete feed are listed in Table 2. It is important to consider that recommendations are made for the nutrient content of the nutritionally complete portion of the diet rather than for specific nutritionally complete diets themselves. Inclusion of a nutritionally complete feed that meets the specifications, in combination with other items, can allow for the formulation of a diet that meets the proposed nutrient guidelines (Table 1). Based on the combination of vertebrate and invertebrate prey and produce, nutritionally complete feeds can be included in the diet at levels of 40% or greater to meet the nutrient guidelines for koris.

Zoo Diet Recommendations

Based on the reported foraging strategy of free ranging kori bustards, proposed diet proportion guidelines are presented in Table 3. These guidelines assist with diet formulation by proportion in order to insure that nutrient needs are met (and levels of specific nutrients are not grossly exceeded, i.e. protein). It may work best when formulating a diet using the table to select the desired proportions of items present in smaller amounts (vertebrate prey, invertebrate prey, and produce), and use nutritionally complete food items to round out 100% of the total diet. When ingredients are combined according to the proportions recommended in Table 3, diets can be formulated to meet the proposed nutrient guidelines for koris.

Hand-rearing Diet

Few data are available regarding successful hand-rearing of kori bustard chicks.[7] All reported hand-reared chicks prior to 2003 have developed angel wing, a condition linked to high protein diets in waterfowl and cranes.[4,11] In 2003, consumption data was recorded by weight for two hand-reared chicks. One chick developed angel wing and one chick did not. The chick that developed angel wing consumed a 33% protein diet between days 1-5, compared to 28% for the chick that did not develop angel wing. The growth rate of the chick that developed angel wing was 5.4% of body weight during that period, compared to 5.0% of body weight in the chick that did not. Growth rate of previously hand-reared chicks that developed angel wing ranged from 5.7-8.1% of body weight on a daily basis (mean = 6.8).[3] Whereas fast growth is important for domestic birds with significant muscle mass, it is not the goal for captive non-domestic birds. Angel wing in waterfowl and cranes was successfully "treated" by reducing the crude protein content of the diet offered. For hand-reared koris it may be more appropriate to maintain dietary protein levels that allow normal growth in waterfowl and cranes (18-22%). In cranes, this was achieved via a purposeful reduction of methionine and cystine in the diet.[11] Such a purposeful restriction in sulfur-containing amino acids is not recommended for growing koris at this time.

Conclusions

Additional hand-rearing data is needed to better determine the cause(s) of angelwing in chicks. When hand-rearing, it is imperative that food intake be recorded by weight of each individual food item. This will allow better determination of nutrient content through the early growth period. Growth rates should be restricted to less than 5% of body weight per day (measured daily).

Determination of the actual nutrient content of free-ranging kori diets is needed. Samples of food items observed to be consumed by koris could be analyzed for nutrient content. It will be difficult to determine the contribution of each item in the total diet, but nutrient content may shed some light on gross seasonal or developmental consumption differences.

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Table 1. Proposed nutrient guidelines for kori bustards on a dry matter basis.*

Nutrient	Proposed Nutrient Guidelines 2004
Protein, %	16.5-30.0**
Fat, %	-
Crude Fiber, %	-
Calcium, %	0.66-2.75**
Phosphorus, %	0.33-1.0**
Calcium : Phosphorus Ratio	-
Potassium, %	0.44-0.72
Sodium, %	0.13-0.18
Magnesium, %	0.05-0.06
Copper, mg/kg	5.5-8.8
Iron, mg/kg	55-77
Zinc, mg/kg	55-70.1
Manganese, mg/kg	66-72
Selenium, mg/kg	0.2
Iodine, mg/kg	0.33-0.44
Vitamin A, IU/kg	165-550
Vitamin D3, IU/kg	22-120
Vitamin E, IU/kg	11.0-27.5
Thiamin, mg/kg	2.2
Riboflavin, mg/kg	2.75-4.4
Pyridoxine, mg/kg	3.3-5.0
Vitamin B12, mg/kg	0.003-0.01
Biotin, mg/kg	0.11-0.25
Choline, mg/kg	990-1650
Folacin, mg/kg	0.8-1.1
Niacin, mg/kg	22-71.5
Pantothenic Acid, mg/kg	10.5-17.6

* Target values based on NRC and Anderson.[1,9]

** Values at high end of range for breeding only.

Table 2. Suggested specifications for appropriate nutritionally complete feeds for inclusion in kori bustard diets.[1]

Nutrient	Specifications
Protein, %	12.0-25.0
Fat, %	2.0 min
Crude Fiber, %	16.0 max
Calcium, %	0.9-4.0*
Phosphorus, %	0.3-1.9*
Calcium : Phosphorus Ratio	
Potassium, %	0.6 min
Sodium, %	0.13 min
Magnesium, %	0.2 min
Copper, mg/kg	9.5 min
Iron, mg/kg	130.0 min
Zinc, mg/kg	55.0 min
Manganese, mg/kg	66.0 min
Selenium, mg/kg	0.2 min
Iodine, mg/kg	0.4 min
Vitamin A, IU/kg	650 min
Vitamin D3, IU/kg	50 min
Vitamin E, IU/kg	35.0 min
Thiamin, mg/kg	5.5 min
Riboflavin, mg/kg	3.0 min
Pyridoxine, mg/kg	5.0 min
Vitamin B12, mg/kg	0.003 min
Biotin, mg/kg	0.2 min
Choline, mg/kg	890 min
Folacin, mg/kg	1.1 min
Niacin, mg/kg	68.0 min
Pantothenic Acid, mg/kg	11.0 min

* High end of range is maximum for breeding individuals.

[1] A feed with these specifications will help meet the probable nutrient requirements of koris when included in the diet according to the proportions described in Table 3.

Table 3. Kori recommended diet proportion guidelines (as fed basis).

Item	Minimum, Percent of Diet	Maximum, Percent of Diet
Vertebrate Prey	0	25
Invertebrate Prey	5	30
Nutritionally Complete Feeds*	40	55**
Produce (50% apple, 50% lettuce)	10	20

* Nutritionally complete feeds are those designed to meet specific recommended nutrient levels.

** Diets which exceed 55% complete feeds can be considered. A diet comprised of 75% complete feed has maintained captive koris.[1]