PRELIMINARY EFFORTS ON HAND-REARING THREE SPECIES OF FLAMINGOS

Mike Maslanka, MS and Ann Ward, MS

Nutritional Services Department, Fort Worth Zoo, Fort Worth, Texas

Abstract

Between 2002 and 2005, the Fort Worth Zoo has hand-reared 37 flamingo chicks: nine Caribbean (*Phoenicopterus ruber ruber*), seventeen lesser (*Phoeniconaias minor*), and eleven Chilean (*Phoenicopterus chilensis*). The chicks were raised from hatching to the point of self-feeding. Body weight and formula consumption were measured daily. Feeding schedule transitions (from ten feedings per day to weaning) were based on body weight and growth rate for each chick. The nutrient content of the formula was compared to a target nutrient range for growing flamingos, and the nutrient content of actual crop milk samples collected from free-ranging Caribbean flamingo chicks.

Introduction

Crop milk is a prolactin-mediated holocrine secretion produced by adult pigeons, doves, flamingos, and some species of penguins to support their young.[2] Flamingos support their young for up to six months with crop milk. In cases when adults are not able to rear chicks, chicks must be offered a diet that allows them to maintain adequate growth and development. By hand-rearing flamingos in captivity, the Fort Worth Zoo has increased both chick survival and opportunities for fertile pairs to multiple clutch during breeding season, in order to bolster the captive population. Successful hand-rearing is based on a formula that meets the nutrient needs of the chicks as they develop. In addition, it is important that the formula be readily digested by the chicks, remain a homogenous mix during feeding, and be of proper consistency for delivery via a feeding tube.

Methods

The formula used at the Fort Worth Zoo is based on a formula initially used by Sea World and Smithsonian's National Zoo (Table 1). This formula met the target nutrient values proposed for growing flamingos (Table 2) and was kept consistent across species. The formula was tube fed at 40-45% of body weight per day, regardless of species. The chicks did not beg for additional food after tube feeding. Growth rates were maintained at less than 10% of body weight per day. Most chicks were not offered formula until two days post-hatch to allow for yolk sac absorption. The feeding schedule began with 10 feedings per day, and was reduced to 5 feedings per day in a stepwise fashion by day 10. Feedings per day were further reduced based on weight gain and age through weaning/self-feeding. The chicks were housed singly or in pairs, based on space constraints, and were offered a free-choice flamingo pellet (PMI Nutrition International, Brentwood, MO) from 10 days of age.

Results and Discussion

Growth rates were maintained at less than 10% of body weight per day in order to minimize complications associated with fast growth (leg and wing deformities). Throughout the entire hand-rearing period, the Caribbean chicks had the fastest rate of growth, 32.5 ± 4.9 g per day (mean ± SD), compared to Chilean (21.9 ± 3.4 g per day) and lesser chicks (12.2 ± 4.1 g per day; Table 3; Figure 1).

Of the three species, Caribbean flamingos historically in the Fort Worth Zoo collection have the greatest mean adult weight (2932 g, n = 88), followed by Chileans (2540 g, n = 111), and lessers (1474 g, n = 42). The lesser chicks reached the greatest proportion of adult weight (95.9 %) by weaning, compared to Chileans (77.4 %) and Caribbeans (65.5 %; Table 3).

The relationship between adult body weight in grams (X) and growth rate (Y) was described in Robbins for precocial land birds as ($Y = 0.02X^{0.91}$), and altricial land birds as ($Y = 0.21X^{0.72}$).[5] Flamingos are considered semi-precocial. The formula for precocial land birds underpredicted growth for Caribbean flamingos and overpredicted growth for Chilean and lesser flamingos (Table 4). The formula for altricial land birds considerably overestimated growth for all birds.

Because Caribbean chicks grew faster than the other two species, they were weaned at a younger age than the other two species (on average 54.9 days vs. 89 days, Table 3).

The Chilean chicks consumed more energy (calculated gross energy) via the formula on average per day during the hand-feeding period than the lessers or Caribbeans (92.8 kcals vs. 59.7 kcals and 48.8 kcals, respectively). The contribution of the pelleted diet to overall energy intake was not determined.

The formula contained 0.588 kcals per gram as mixed. The energy content of the crop milk samples was not determined. Several nutrients appear quite different between the crop milk and hand-rearing formula. One noteworthy example is calcium, which comprises 1.4% of the formula on a dry matter basis, and only 0.1% of the actual crop milk sample.[6] In addition, fat content on a dry matter basis in the formula is about half of that found in the actual crop milk sample. These differences, although noteworthy, do not seem to influence the success of the current formula.

Conclusions

Each of the flamingo species exhibited a different growth rate when tube fed with the same hand-rearing formula. In order to minimize the period of hand-rearing the chicks, a faster growth rate within the prescribed parameters (less than 10% of body weight gain per day) is desirable. The future goals include:

(1) Developing a formula that mimics the nutrient content of actual flamingo crop milk as known. Although the nutrient content of crop milk is expected to change during the 6 month feeding period, values which represent 7-10 week old chicks serve as a good starting point for formulation changes.

(2) Quantifying the consumption of the pelleted ration daily through the hand-rearing period to have a better idea of daily energy intake from all sources.

We seek to alter the formula to simplify ingredients, and reduce labor involved in formula preparation and in actual hand-rearing, while developing a formula that more closely mimics the nutrient content of actual crop milk.

LITERATURE CITED

1. AAFCO (Association of American Feed Control Officials). 1994. Pet Food Regulations. In: AAFCO Official Publication. Atlanta. AAFCO, Inc.
2. Kirk-Baer, C. 1999. Comparative Nutrition and Feeding Considerations of Young Columbidae. *In* Zoo and Wild Animal Medicine – Current Therapy 4. Fowler, M.E. and Miller, R.E, Eds. W.B. Saunders Co, Philadelphia, PA.
3. NRC (National Research Council). 1994. Nutrient Requirements of Poultry. National Academy Press, Washington, DC.
4. NRC (National Research Council). 1986. Nutrient Requirements of Cats. National Academy Press, Washington, DC.
5. Robbins, C.T. 1993. Wildlife Feeding and Nutrition. Academic Press, Inc. New York, NY.
6. Ward, A., A. Hunt, M. Maslanka, and C. Brown. 2001. Nutrient Composition of American Flamingo Crop Milk. Proc AZA NAG Fourth Conference on Zoo and Wildlife Nutrition. Edwards, M., K. Lisi, M. Schlegel, and R. Bray, Eds. Lake Buena Vista, FL.

Table 1. Fort Worth Zoo flamingo hand-rearing formula (as mixed).

Ingredient	Percent of Diet
Peeled bait shrimp	8.1
Lake smelt	8.1
Hard-boiled egg yolk	8.1
Gerber Mixed baby cereal[1]	4.1
Vionate[2]	0.2
Calcium carbonate	0.2
Boiled water	71.2
Total	100

[1] Gerber Products Company, Fremont, MI 49413

[2] Gimborn Pet Specialties, LLC, 4280 N.E. Expressway, Atlanta, GA 30340

Table 2. Nutrient content of flamingo formula compared to target nutrient values and actual crop milk nutrient content (dry matter basis unless noted).

Nutrient	Flamingo Formula[1]	Target Nutrient Values[2]	Actual Crop Milk[3]
Dry Matter, %	11.5	-	14.3
Energy, kcals/g	0.588	-	-
		Dry Matter Basis	
Crude Protein, %	35.4	25.0-30.0	34.8
Fat, %	31.5	9.0	60.5
Crude Fiber, %	5.3	-	-
Ash, %	6.0	-	-
Calcium, %	1.4	1.0	0.1
Phosphorus, %	0.9	0.4-0.8	0.4
Magnesium, %	0.1	0.06-0.08	0.04
Potassium, %	0.4	0.25-0.6	0.3
Sodium, %	0.3	0.15-0.2	-
Iron, mg/kg	262.0	80	196.0
Zinc, mg/kg	92.0	40-75	24.2
Copper, mg/kg	4.0	5.0	26.6
Manganese, mg/kg	11.7	-	-
Vitamin A, IU/g	-	1.5-5.0	-
Vitamin D3, IU/g	-	0.2-0.5	-
Vitamin E, IU/g	-	30.0-80.0	-
Thiamin, mg/kg	-	1.0-5.0	-
Riboflavin, mg/kg	-	4.0	-
Niacin, mg/kg	-	27.0-60.0	-
Pyridoxine, mg/kg	-	3.0-4.0	-

[1] Actual analyzed values (Dairy One, Ithaca, NY).

[2] Target nutrient values based on known requirements for growing poultry and growing carnivores.[1,3,4]

[3] Values represent mean of 102 samples collected between 1999-2001 for birds between 7-10 weeks of age.[6]

Table 3. Flamingo chick growth parameters.

	Mean ± SD		
Parameter	Caribbean	Chilean	Lesser
n	9	11	17
Growth Rate, g/d	32.5 ± 4.9^{a}	21.9 ± 3.4^{b}	12.2 ± 4.1^{c}
Energy Intake, FORMULA ONLY, kcals/d*	49.3 ± 4.7^{a}	92.8 ± 9.3^{b}	55.9 ± 28.7^{a}
Wean Weight, g	1919.3	1965.0	1414.0
Adult Weight, g**	2932	2540	1474
Percent of Adult Weight at Weaning	65.5	77.4	95.9
Day of Age at Weaning	54.9	89.0	89.6

[a,b,c] means within the same row with different superscripts differ ($p < 0.05$).

* Pellets (unmeasured) also were consumed from 10 days of age.

** Adult weight is mean weight of all measurements for each species at the Fort Worth Zoo.

Table 4. Predicted growth rates[5] for flamingos compared to actual.

	Growth Rate, g/d		
	Altricial Formula $0.21BWg^{0.72}$	Precocial Formula $0.02BWg^{0.91}$	Actual
Caribbean	65.9	28.6	32.5
Chilean	59.4	25.1	21.8
Lesser	40.1	15.3	12.2

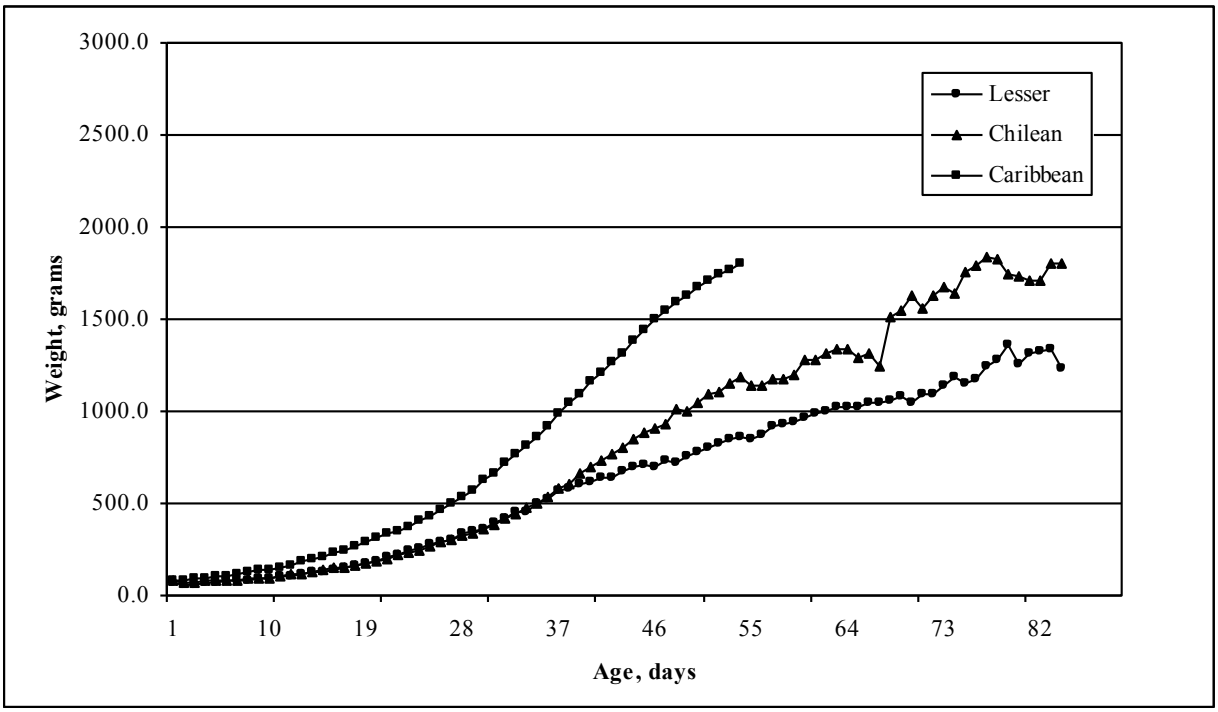

Figure 1. Comparative growth across three flamingo species.