Considerations for Kinkajou Captive Diets

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KEYWORDS

• Kinkajou • *Potos flavus* • Diet • Feeding
• Nutritional diseases • Diabetes mellitus

Kinkajous (*Potos flavus*), also known as honey bears or nightwalkers, belong to the family Procyonidae, which includes raccoons, coatis, ringtails, and olingos. Kinkajous are readily available in the pet trade as wild-caught, imported adults and captive-bred babies.

NATURAL HISTORY

The kinkajou is an arboreal species primarily found in canopies of neotropical primary rainforests throughout Central America and northern South America. Kinkajous are one of two carnivores with a prehensile tail; the binturong (*Arctictis binturong*), an Asian viverrid, is the other one. We are gradually increasing our understanding of the kinkajou's social life from field studies in Panama, but given the wide distribution of this taxon, it is likely that population-specific differences in diet and social organization exist. For example, two male siblings often live with an unrelated female and her offspring. Some females are more solitary and are only found with their young from that year; these animals seem to roam widely rather than hold territories.[1–4]

Kinkajou population density, which may range from 12 to 74 kinkajous per km^2, seems to relate to the number of fruiting trees within a forest. The size of home range also varies with gender. Males typically occupy 30 to 40 ha, whereas females occupy 15–18 hectares (ha).[1–4] Captive kinkajous are maintained in more confined spaces than their free-ranging counterparts, so animals should be given numerous opportunities for activities that simulate naturalistic behaviors (eg, foraging) to reduce the potential for developing stereotypies. Kinkajous commonly overeat and become obese if their captive environment lacks sufficient mental and physical challenges to engage their interests and activities (K. Wright, DVM, personal observations, 1993–2009).

Free-ranging kinkajous have a primarily frugivorous diet and consume a wide variety of seasonally available fruits throughout the year. Although fruit, nectar, and leaves

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seem to comprise their main diet, insects are a small but not insignificant portion. A population in Parque National Soberanía in Panama consumed almost exclusively fruits (90% as observed in feeding bouts, and 99% as observed via scat), with the remaining diet composed of nectar and leaves. They did not consume any insects or animal matter.[4–6] Fruit is the main water source (eg, preformed water) for wild kinkajous, and they often hang upside down while consuming water-rich fruits to avoid spilling a drop of juice (**Fig. 1**). Seeds often pass through the gastrointestinal tract undigested, which makes kinkajous excellent seed dispersers. They have 20-cm long tongues to collect nectar and pollen, and they are the known only carnivore that pollinates flowers (**Fig. 2**).

NUTRIENT AND ENERGY REQUIREMENTS

Nutrient requirements of kinkajous have not been studied clearly or defined under controlled conditions. To establish nutrient guidelines for practical feeding programs for exotic species such as kinkajous, we must evaluate gastrointestinal tract anatomy, types and nutrient content of foods consumed by free-ranging animals, and nutrient content of diets offered to animals in managed environments. A kinkajou's intestine is simple, without a cecum,[7] and it does not seem to have any grossly visible specialization for frugivory. Unfortunately, details of gastrointestinal tract anatomy and physiology are lacking, as is information on the nutrient content of free-ranging kinkajou diets. As a result, practical diets are extrapolated from the nutrient requirements of domestic dogs,[8] which are omnivorous distant relatives of kinkajous, and certain neotropical primates, which have similar foraging behaviors and food sources to kinkajous and are often found exploiting the same fruiting trees.[9]

Fig. 1. Kinkajous frequently hang upside down as they eat certain foods, particularly juicy ones like grapes. (*Courtesy of* K. Wright, DVM, Mesa, AZ.)

Fig. 2. Kinkajous pollinate many plant species as they forage for nectar. (*Courtesy of* K. Wright, DVM, Mesa, AZ.)

In the wild, fruit is considered a limiting food resource, especially for females. One study demonstrated a 2-month lag in body weight after low fruit production months.[10] Free-ranging kinkajous' activity budgets correlate with fruit abundance. When fruit is abundant, males eat less and rest more, whereas females eat less and travel more. This gender difference is hypothesized to be caused by differences between sexes in nutritional needs. Males presumably require a less nutrient-dense diet than pregnant females and are likely to rest and socialize when fruit is abundant. Females, by contrast, must forage more to find fruits with higher nutrient densities (eg, figs with calcium, protein) to support fetal development and nursing of offspring.[10,11]

A kinkajou needs approximately 50 kcal/d less than an equivalently sized mammal along the mouse-elephant (placental mammal) body curve because its basal metabolic rate is 30% to 34% lower.[6,12,13] A kinkajou diet created with daily kilocalories calculated from the metabolic rate formula for typical mammals provides too much food. As a result, kinkajous tend to be at greater risk for obesity when fed food quantities that are fed to other similarly sized mammals or when allowed to feed freely. A kinkajou's mean basal metabolic rate is approximately 0.316 mL O_2/g/h.[12] Foods need to be more nutrient dense (ie, amount of nutrient per kilocalorie consumed) to meet presumed nutritional needs without encouraging obesity. To prevent obesity and lessen the likelihood of diabetes mellitus, pancreatitis, arthritis, and cardiovascular diseases, especially in older kinkajous, caloric intake must be limited.

A kinkajou's body temperature ranges from nighttime active levels of 38.1 $\pm$ 0.4°C to daytime resting levels of 36.0 $\pm$ 0.6°C.[12] They cannot cool well through evaporation, and they show signs of heat stress when temperatures are higher than 33°C.[12,13] Their lowered metabolism also causes kinkajous to be less tolerant of cool temperatures. Kinkajous start to show heat-conserving postures and behaviors (eg, retreating to nest box, coiling with head buried between the thighs) when temperatures are below 15°C, and they show signs of hypothermic stress when temperatures drop to 5°C or less for more than a few hours (K. Wright, DVM, personal observation, 1993).

Kinkajous are extremely long-lived, with life spans commonly reaching two to four decades. Diets should be designed for life stages. A juvenile diet that supports growth and development should be fed for the first 12 to 18 months of life; an active adult diet should be fed into the second and possibly third decades (but discontinued when a female becomes reproductively senescent); a senior adult diet, with fewer calories

and a shift in nutrients for reproductively senescent females and older males, should be fed after that. Given kinkajous' extreme longevity, geriatric diets that emphasize lower fat, increased levels of glucosamine and chondroitin, high-quality protein, and complex carbohydrates should be developed.

PRACTICAL DIETS

Diets offered to kinkajous in captivity, both in zoos and in private collections, tend to be overly complex and not representative of the species' natural diet in either ingredients or nutrients. In the authors' opinion, such diets are typically inadequate and potentially detrimental to health. A healthy and sound feeding program should be based on availability of nutritionally balanced foods. When consumed in appropriate quantities, these required foods are a source of consistent and reliable nutrition. The consumption of required foods safely allows caretakers to offer smaller amounts of nutritionally incomplete foods, such as commercial produce, insects, and other ingredients.

Fruit consumed by wild kinkajous has lower sugar, starch, and moisture content, higher protein and fiber content, and more concentrated minerals and vitamins than domestically available fruits.[14] Many captive diets include honey or other foods high in simple carbohydrates (ie, starch, sugar). The frequent occurrence of diabetes mellitus in kinkajous suggests that sugar-rich diets may contribute to the incidence of this disease (Mark S. Edwards, PhD, personal observation, 2008).

Captive diets often include raw meat, mice, and chicks, on the assumption that kinkajous catch and eat small animals in the wild. Kinkajous have developed salmonellosis and coliform enteritis and intestinal parasites, such as tapeworms, from consuming raw whole animals or raw meat.[15] Kinkajous do not apparently need these animal-based foods; in fact, field research shows that animal-based foods are a minor portion of the natural diet.[4,10] Free-ranging kinkajous consume plant protein via a variety of tropical fruits that they encounter over the year. There may be deficiencies of certain amino acids, fatty acids, or other nutrients in the fruit diet of free-ranging kinkajous that make consumption of relatively small amounts of animal prey necessary. Given these uncertainties and the probable inadequacy of domestic produce in meeting specific nutrient (ie, amino acids) needs, captive diets typically include animal protein with a balance of dietary essential amino acids (ie, those considered essential for domestic dogs).

A readily available basic diet capable of sustaining growth and reproduction over a 16-year period consists of 8 to 12 oz (227–340 g) of domestic dog kibble with 27% crude protein (eg, Purina Hi Pro, Nestlé Purina PetCare, St. Louis, MO; www.purina.com), 4 to 12 oz (113–340 g) of fresh fruit and/or vegetables, and 1 to 2 oz (28–57 g) of dried fruit. Fresh flowers (eg, hibiscus) and browse (eg, mulberry leaves and berries) may be eagerly eaten by some individuals. Favored fruits are bananas, apples, oranges, kiwi, melons, pears, and strawberries, but they must be given in moderation to prevent sugar overload. Cucumbers, sweet potatoes, corn, and snow peas are typically eaten eagerly. Sweet potato has a nutrient content similar to many wild fruits and is eagerly eaten raw or cooked. Various other seasonally fresh produce should be offered with care to avoid overfeeding any one item and potentially causing dietary deficiencies or imbalances. Figs are high in calcium and are eagerly eaten. Other favored dried fruits are raisins, dates, prunes, papaya, pineapple, and apricots, but overfeeding of these items must be avoided to prevent excess sugar ingestion.

Dog kibble is widely available and inexpensive and has been used long-term to support growth, reproduction, and aging. It seems to be an appropriate, practical,

nutritionally complete food for kinkajous. With applied research and feeding trials, we will be able to more objectively define kinkajous' nutrient needs and how they respond to various foods. Kinkajous are often fed commercially available, extruded primate products as a part of their diet in place of dog kibble. These products may be fed to kinkajous because they are similar in nutrient content to dog kibble and meet the same nutrient needs provided by kibble. As long as caretakers keep in mind the nutrients that various foods provide, they can make dietary substitutions. Selected nutrient composition of foods included in kinkajou diets is given in **Table 1**.

By contrast, the types and quantities of foods included in a practical diet for a single adult kinkajou (BW = 2.89 kg) are provided in **Tables 2** and **3**. The calculated nutrient composition of that diet is compared with the estimated nutrient requirements of dogs (*Canis domesticus*).[8] (Note that values in **Table 2** are 30% less than typical placental mammal metabolic curve and are appropriate for most adult kinkajous. Values in **Table 3** follow the typical placental mammal metabolic curve and may be appropriate for pregnant and lactating kinkajous, growing kinkajous, and kinkajous recovering from severe illness with concomitant weight loss.) These tables provide only guidelines, and clinicians must adjust diet based on individual kinkajous' responses to diet (eg, changes in body condition score, body mass, and other health parameters). Data on the distribution of dry matter and energy of the major food components are provided in **Tables 4** and **5**.

Caution should be exercised in varying from these proven diets. One report provided husbandry and diet information for three male and three female kinkajous over a 2-year period with only a single birth reported.[16] The limited breeding in this study suggested suboptimal husbandry or subclinical disease. Kinkajous are prolific

Table 1
Selected nutrient composition of some foods offered to kinkajous (*Potos flavus*) in managed environments, expressed on a fresh weight and dry matter basis

	Dry Matter, %	Crude Protein, %	Crude Fat, %	Linoleic Acid, %	Crude Fiber, %	Ca, %	P, %	Vitamin A, IU/kg
Dog food, original adult[a]	92.0	27.4	16.3	1.75	2.7	1.32	1.02	18,500
	100	29.8	17.7	1.90	2.9	1.43	1.11	20,108
Puppy chow[b]	88.0	27.0	12.0	1.6	5.0	1.1	0.9	—
	100	30.7	13.6	1.8	5.7	1.3	1.0	—
HiPro dog food[b]	88.0	27.0	15.0	1.2	4.0	1	0.8	10,000
	100	30.7	17.0	1.4	4.5	1.1	0.9	11,364
KMR, canned liquid[c]	18.3	7.7	4.7	—	0.0	0.19	0.16	23,130
	100	42.1	25.6	—	0.0	1.04	0.87	126,393
KMR, powder[c]	97.3	43.0	29.5	—	0.0	1.01	0.89	110,700
	100	44.2	30.3	—	0.0	1.04	0.92	113,772
Leaf-eater food[d]	91.4	23.3	5.0	—	8.2	0.96	0.65	8000
	100.0	25.5	5.5	—	9.0	1.05	0.71	8753
Enfamil poly-Vi-Sol drops[e]	nd	—	—	—	—	—	—	1.5 million
	100	—	—	—	—	—	—	nd

[a] The Iams Company, Dayton, Ohio (www.iams.com).
[b] Nestlé Purina PetCare, St. Louis, Missouri (www.purina.com).
[c] Pet-Ag, Inc., Hampshire, Illinois (www.petag.com).
[d] Marion Zoologic Inc., Plymouth, Minnesota (www.marionzoological.com).
[e] Mead Johnson and Co., Evansville, Indiana.

Table 2
Examples of foods and quantities for feeding a single adult kinkajou (*Potos flavus*) (BW = 2.89 kg) from the Zoologic Society of San Diego and calculated nutrient composition of the offered diet as compared with estimated nutrient requirements of dogs (*Canis domesticus*)

	Food Type	Weight (g)	Schedule
1	Adult chunk dog food[a]	35	Daily
2	Leaf-eater food[a]	21	Daily
3	Roots, variable[b]	35	Daily
4	Vegetables, variable[c]	35	Daily
5	Fruits, variable[d]	35	Daily

Nutrient	Diet Concentration	Dog Requirement	Nutrient	Diet Concentration	Dog Requirement
Proximate			**Energy**		
Dry matter, %	40.3	nd	Metabolizable (ME), kJ/g	15.9	nd
Crude protein, %	24.7	10	**Fat-soluble vitamins**		
Lysine, %	1.2	0.68	Vitamin A, IU/kg	12,635	503
Crude fat, %	11.0	5.5	Beta-carotene, mg/kg	nd	nd
Linoleic acid, %	1.8	1.1	Vitamin D, IU/kg	1213	1380
Neutral detergent fiber (NDF), %	15.8	nd	Vitamin E, mg/kg	178	30
Acid detergent fiber (ADF), %	7.3	nd	Vitamin K, mg/kg	2.8	1.0
Carbohydrate (NDSC), %[e]	41.5	nd			
Minerals			**Water-soluble vitamins**		
Ash, %	7.0	nd	Thiamin, ppm	7.6	2.25
Calcium, %	1.1	0.3	Riboflavin, ppm	12.7	5.25
Phosphorus, %	0.8	0.3	Pyridoxine, ppm	2.6	1.5
Sodium, %	0.3	0.04	Niacin, ppm	47	15
Potassium, %	1.0	0.4	Biotin, ppb	303	nd
Magnesium, %	0.1	0.06	Choline, ppm	1342	1700
Iron, ppm	177	30	Pantothenic acid, ppm	26	15
Copper, ppm	36	6	Cyanocobalamin, ppb	89.5	35
Manganese, ppm	48.8	5.0	Vitamin C, ppm	673	
Selenium, ppm	0.29	0.35			
Zinc, ppm	129	60			

All nutrient concentrations, except dry matter, are expressed on a dry matter basis (DMB).
Abbreviation: nd, not determined.
[a] Selected nutrient analysis provided in Table 1.
[b] Variable roots may include, but are not limited to, beets, carrots, parsnips, sweet potatoes, turnips.
[c] Variable vegetables may include, but are not limited to, broccoli, corn, green beans.
[d] Variable fruits may include, but are not limited to, apples, bananas, grapes, melons, oranges, tomatoes.
[e] NDSC (neutral detergent soluble carbohydrates) = 100 – crude protein,% + crude fat,% + neutral detergent fiber,% + ash,% (all DMB).
M. Edwards, PhD, unpublished data, 2007.

on the dog kibble diet (described previously), and one pair on this diet produced a single offspring every 5 to 6 months for more than a decade (K. Wright, DVM, personal observations, 1993–2003).

Kinkajous are arboreal and have the tendency to ignore food that drops out of their hands during processing or eating. The food amounts noted previously are for

Table 3
Examples of foods and quantities for feeding a single adult kinkajou (*Potos flavus*) (BW = 2.89 kg) with special needs (ie, lactation, pregnancy, or illness) from the Zoologic Society of San Diego and calculated nutrient composition of the offered diet as compared with estimated nutrient requirements of dogs (*Canis domesticus*)

	Food Type	Weight (g)	Schedule
1	Adult chunk dog food[a]	50	Daily
2	Leaf-eater food[a]	30	Daily
3	Roots, variable[b]	50	Daily
4	Vegetables, variable[c]	50	Daily
5	Fruits, variable[d]	50	Daily

Nutrient	Diet Concentration	Dog Requirement	Nutrient	Diet Concentration	Dog Requirement
Proximate			**Energy**		
Dry matter, %	40.1	nd	Metabolizable (ME) kJ/g	3.81	nd
Crude protein, %	24.7	10	**Fat-soluble vitamins**		
Lysine, %	1.2	0.68	Vitamin A, IU/kg	12,635	503
Crude fat, %	11.0	5.5	Beta-carotene, mg/kg	nd	nd
Linoleic acid, %	1.8	1.1	Vitamin D, IU/kg	1213	1380
Neutral detergent fiber (NDF), %	15.8	nd	Vitamin E, mg/kg	178	30
Acid detergent fiber (ADF), %	7.3	nd	Vitamin K, mg/kg	2.8	1.0
Carbohydrate (NDSC), %[e]	41.5	nd			
Minerals			**Water-soluble vitamins**		
Ash, %	7.0	nd	Thiamin, ppm	7.6	2.25
Calcium, %	1.1	0.3	Riboflavin, ppm	12.7	5.25
Phosphorus, %	0.8	0.3	Pyridoxine, ppm	2.6	1.5
Sodium, %	0.3	0.04	Niacin, ppm	47	15
Potassium, %	1.0	0.4	Biotin, ppb	303	nd
Magnesium, %	0.1	0.06	Choline, ppm	1342	1700
Iron, ppm	177	30	Pantothenic acid, ppm	26	15
Copper, ppm	36	6	Cyanocobalamin, ppb	89.5	35
Manganese, ppm	48.8	5.0	Vitamin C, ppm	673	
Selenium, ppm	0.29	0.35			
Zinc, ppm	129	60			

All nutrient concentrations, except dry matter, are expressed on a dry matter basis (DMB).
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[b] Variable roots may include, but are not limited to, beets, carrots, parsnips, sweet potatoes, turnips.
[c] Variable vegetables may include, but are not limited to, broccoli, corn, green beans.
[d] Variable fruits may include, but are not limited to, apples, bananas, grapes, melons, oranges, tomatoes.
[e] NDSC (neutral detergent soluble carbohydrates) = 100 – crude protein, % + crude fat, % + neutral detergent fiber, % + ash, % (all DMB).
M. Edwards, PhD, unpublished data, 2007.

kinkajous kept in cages with wire bottoms that allow dropped food to fall out of reach to a cleaning tray below. For kinkajous kept on solid floors, a slightly smaller amount of food may be needed. To obtain optimum body condition, withholding dog kibble on intermittent days may be required. A reduction in food quantity or a fast day every

Table 4
Suggested distribution of mass, dry matter and dietary energy of foods and a diet for feeding adult kinkajous (*Potos flavus*)

		Dry Matter		Metabolizable Energy		
Food Item	Amount g	%	g	kJ per g (fresh weight)	kJ	% Distribution
Dog food	35	91.98	32.2	16.98	594.3	57.75
High-fiber primate diet	21	91.40	19.2	11.67	245.1	23.81
Roots	35	12.21	4.3	1.81	63.4	6.16
Vegetables	35	16.07	5.6	1.16	40.6	3.95
Fruit	35	9.31	3.3	2.45	85.8	8.33
Total	**161**	—	**64.5**	—	**1029.2**	**100**

1 to 2 weeks, sometimes separated by as little as 48 hours, is tolerated well and simulates periods of reduced food availability when free-ranging kinkajous seek out new fruiting trees within their territories.

Food presentation is important to engage kinkajous by prolonging foraging and eating (see later discussion). By slowing the process of finding, grasping, and manipulating and ultimately consuming food morsels, a kinkajou has more time to develop satiety through a combination of stretch receptors in the stomach responding to the increasing volume of ingesta and chemosensory receptors throughout the body responding to elevated blood levels of glucose and fats. Careful feeding practices prevent gorging and overfeeding.

LIFE STAGE CONSIDERATIONS

Neonates and Juveniles

A single, or rarely two, offspring are born after a 112- to 118-day gestation period.[17] Neonatal kinkajous weigh 130 to 220 g, with twins weighing toward the lower end of this range (K. Wright, DVM, personal observations, 1993–2003). Pelage is gray with a dorsal black stripe, which changes to gold by weaning (**Figs. 3** and **4**). Variations in pelage coloration may be associated with subspecies. Eyes open at 7 to 25 days.[18] Juvenile kinkajous typically begin sampling solid foods at 6 to 7 weeks of

Table 5
Suggested distribution of mass, dry matter, and dietary energy of foods and a diet for feeding kinkajous (*Potos flavus*) with special needs (ie, lactation, pregnancy, or illness)

		Dry Matter		Metabolizable Energy		
Food Item	Amount g	%	g	kJ per g (fresh weight)	kJ	% Distribution
Dog food	50	91.98	49.88	16.98	849	57.75
High-fiber primate diet	30	91.40	29.74	11.67	350	23.81
Roots	50	12.21	6.2	1.81	90.5	6.16
Vegetables	50	16.07	8.7	1.16	58.0	8.33
Fruit	50	9.31	5.1	2.45	122.5	3.95
Total	**230**	—	**92.21**	—	**1470**	

age[17] or earlier (K. Wright, personal observations, 1993–2003). Baby kinkajous should be left with the mother until at least partially weaned (8–9 weeks of age). Animals may hang using their prehensile tails at this age.[17]

Juveniles are often sold before they are fully weaned with the mistaken belief that this makes them better pets. In the authors' experience, weaned kinkajous that are allowed to live with their parents for at least 4 months make just as dependable pets as those removed from their parents at earlier ages and are less prone to developing behavioral vices, such as paw or tail sucking.

Although there are different hand-rearing diets published in older literature,[19,20] the readily available commercial product KMR (Kitten Milk Replacer, Pet-Ag, Inc., Hampshire, IL, www.petag.com) has been used as a wholesome diet for unweaned kinkajous. Moistened, banana-flavored rice baby cereal and crushed fresh banana can be used as initial solid food and quickly replaced by a moistened, dry dog food formulated for puppies. On a daily basis, incremental amounts of the moistened, dry dog food can be mixed with rice cereal/banana mixture. Dry extruded morsels typical of commercially available dog foods may not be eaten until 4 to 6 months of age, when adult teeth start erupting. Puppy kibble should be fed for the first year of life and then replaced with an adult dog food diet. Kinkajous that are kept on the cereal and banana mix too long before receiving dog kibble may develop mild metabolic bone disease manifested by an excessive plantigrade gait (angle of joint $< 45^{\circ}$). Supplementing each feeding of the cereal and banana mixture with one to two drops of a children's pediatric vitamin (eg, Enfamil Poly-Vi-Sol, Mead Johnson and Co., Evansville, IN) and 1 mL of calcium glubionate (calcionate syrup, 1.8 g/5 mL, Rugby, Duluth, GA) per 1000 g of kinkajou bodyweight helps prevent this disorder. Caregivers always

Fig. 3. Adult female with 7-day-old baby. (*Courtesy of* K. Wright, DVM, Mesa, AZ.)

Fig. 4. Newborn kinkajou less than 24 hours old. (*Courtesy of* K. Wright, DVM, Mesa, AZ.)

should be aware of potential oversupplementation when adding vitamins to an already nutritionally complete food, such as dog kibble.

At weaning (60–100 days), a kinkajou readily follows larger moving objects, such as people and dogs. Most of them prefer to explore areas around where people are stationary and curl up to sleep in the crook of a human's arms or lap or other dark warm place. Hopping and running usually start by 12 weeks of age, and independent exploration, away from the leader, usually starts by 16 weeks of age. Mouthing and teething on the caregiver's fingers may start as early as 6 weeks of age. Dangerous aggression can build if this behavior is allowed to continue.

Adults

Body weights reported for free-ranging animals and from one population of captive kinkajous are provided in **Table 6**. Male kinkajous reach sexual maturity at 14 to 18 months. Females mature later, at 20 to 30 months. Females often rebreed during a postpartum estrus. In captivity, such females demonstrate an interbirth interval of 150 days and produce two offspring annually (K. Wright, DVM, personal observations, 1993–2003). This is in contrast to one offspring per year, which is typical for free-ranging females.[18]

Geriatric Kinkajous

In captivity, kinkajous typically live at least 15 to 20 years. Many living specimens are three decades old, however, and one specimen, Sugar Bear at the Honolulu Zoo, lived to be 41 years old (www.honoluluzoo.org/kinkajou.htm).

BODY CONDITION SCORES

Body condition scoring is an essential part of the health examination of domestic dogs and cats but is frequently overlooked with exotic pets. Using a score of 1 to 5, with 1 representing an emaciated kinkajou, 3 being a healthy weight, and 5 being an obese animal, clinicians should record body condition scores, in conjunction with body weight, on every physical examination.

A healthy kinkajou looks sleek from all sides, similar to a domestic cat (**Fig. 5**). From above, the ribs, abdomen, and hips are in a nearly straight line. A lateral view shows a slightly concave abdomen and clearly defined shoulders and hips. The tail coils readily, is strong, and easily supports the kinkajou's weight. Fat accumulates such that the abdomen becomes convex and eventually pendulous when viewed from

Table 6
Body weight of free-range and captive kinkajous (*Potus flavus*)

		Body weight				
Status	**Gender**	**Mean (kg)**	**Range (kg)**	***n***	**Location**	**Reference**
Free range	B	3	—	—	French Guiana	[7]
	B	2	—	—	Mexico	[21,22]
	B	2.5	—	—	Surinam	[17]
	F	1.65	—	—	Surinam	[23]
	M	1.62	—	—	Surinam	[23]
	B	2.5	—	—	Venezuela	[24]
	B	—	1.4–4.6	—	not reported	[a]
Captive	M	3.59	1.90–4.75	3	San Diego, CA	[a]
	F	2.48	1.70–3.75	2	San Diego, CA	[a]

Abbreviations: B, both male and female; F, female; M, male; U, gender unreported.
[a] M. Edwards, PhD, unpublished data, 2005.

the side, the shoulders disappear beneath fat, and the hips appear rounded, rather than angular (**Fig. 6**). The tail base becomes soft, and the tail cannot coil tightly. The kinkajou can support its own weight by a tail coiled around a hand but appears uncomfortable and cannot sustain an upside-down position for long. Fat accumulates around the neck and on the forehead, which causes the kinkajou's profile to appear slightly swollen and rounded. An emaciated kinkajou develops readily visible bony crests on its skull, the bones of the shoulders and ribs may be visible or easily palpable with slight digital pressure, and the hips appear sunken. The tail becomes listless and cannot coil to support the kinkajou's weight.

ENRICHMENT

Food presentation plays a significant role in engaging a kinkajou and is important in minimizing the development of abnormal behaviors and unhealthy body condition scores. Caregivers are encouraged to seek methods of enrichment that do not include

Fig. 5. The worn teeth of a kinkajou older than 20 years. The black staining varies with age and may be confused with tartar and calculus. (*Courtesy of* K. Wright, DVM, Mesa, AZ.)

Fig. 6. This juvenile kinkajou has a body condition score of 3. (*Courtesy of* K. Wright, DVM, Mesa, AZ.)

food, such as training, olfactory stimuli, or new objects that stimulate scent marking. If food must be included in the enrichment plan, the authors promote the incorporation of novel methods for delivering the animal's nutritionally balanced diet rather than diluting the diet by adding nutritionally incomplete foods (eg, dried and fresh fruits, meat, and egg). Offering food in a covered bucket with feeding holes on its sides protects the food from soiling by the animal. It also makes foraging an essential part of feeding, because the kinkajou has to learn how to scoop food out of the bucket holes. Placing interfering objects, such as plastic balls (eg, Wiffle Ball, The Wiffle Ball Inc., Shelton, CT), or 4- to 6-cm hard rubber toys (eg, Ferret Treasure/Kong Ferret, Kong Company, Golden, CO), into the bucket along with kibble adds further challenge to the foraging experience. Another simple foraging container is a cube of wire (with 1- to 2-in gaps between the wire), so the kinkajou has to work to get the food out or try to eat it through the small openings in the cube's sides.

Additional enrichment may be provided easily by putting food treats inside 1- or 2-L soda bottles. These foods can be loaded in the bottle to be shaken out by the kinkajou, or if the animal is impatient, it may chew a hole in the bottle to more readily access the food. In more than 15 years of using this technique, caregivers have never noted a problem with a kinkajou eating plastic pieces from the bottles. A small amount of maple syrup can be put inside a bottle to keep the food pieces stuck to the insides of the bottle and make it more difficult for the animal to access the food. Paper towel holders, small boxes, and small hard plastic bottles are other readily available toys. Many kinkajous learn to unscrew bottle caps from soda bottles and may even open complicated locks. Polyvinylchloride (PVC) pipe toys can be made for hiding food, and a drip system in which a small amount of honey drips from a PVC pipe suspended above the cage, beyond the kinkajou's reach, keeps them focused for hours. Honey should be used sparingly to prevent diabetes mellitus.

Treats of cooked chicken or other meats are good training rewards. Sugary food may induce excitable behaviors that conflict with disciplined training. Feeding sugary food before or during playtime also may increase the risk of unpredictable or undesirable behaviors. Kinkajous may be trained to station, target, or perform other simple behaviors. Proper socialization requires at least 1 hour of combined free contact and training time daily. Providing daily training and appropriate behavioral enrichment helps prevent development of stereotypic and destructive behaviors.

NUTRITIONAL DISORDERS

Nutritional Secondary Hyperparathyroidism

This disorder results from diets that are calcium deficient, as a result of an absolute calcium deficiency, a relative calcium deficiency compared with phosphorus, or other factors, such as the presence in the diet of compounds that interfere with calcium uptake and absorption. This disease is common in hand-raised kinkajous and kinkajous that are fed fruit- and meat-rich diets. Clinical signs include a reluctance to move or hang by the tail, irritability (perhaps related to pain), shifting from an elevated plantigrade stance to one that collapses on the hocks, a hock angle $< 45^{\circ}$, and deformities of the jaws and long bones (K. Wright, DVM, personal observation, 1995). Correction requires calcium supplementation, often with vitamin D_3, and providing a balanced diet. Pain management is essential for many cases.

Diabetes Mellitus

Despite adequate food intake, polydypsia, elevated blood glucose levels, glycosuria, and weight loss have been observed in several captive kinkajous (Mark S. Edwards, PhD, personal observation, 2008) with diabetes mellitus. Diet modification, including reducing meal size and intake of nonstructural carbohydrates and increasing feeding frequency, can be tried to manage early stages of disease. Fast days should not be part of the management of a kinkajou with diabetes. Prevention of disease, rather than management once it has occurred, is preferable.

Pancreatitis

Pancreatitis may be misdiagnosed if a clinician relies solely on blood amylase and lipase concentrations, because normal values of these enzymes are much higher in healthy kinkajous than in healthy dogs or cats. If these enzyme concentrations are correlated with elevated white blood cell counts, diarrhea, vomiting, and radiographic or ultrasonographic images consistent with pancreatitis, they are more reliable. One kinkajou has been on a diet that replaces dog kibble with a human liquid diet (Ensure, Abbot Laboratories, Abbott Park, IL, www.ensure.com) for several years after a presumed bout of pancreatitis. This kinkajou is also hypothyroid and is slightly overweight.

Obesity

Kinkajous' weights become alarmingly high if they are allowed to feed ad libitum (**Fig. 7**). One kinkajou actually reached a weight of 8.5 kg (D. Eshar, DVM, personal communication, 2008).

Dental Disease

Kinkajous need regular dental prophylaxis under general anesthesia as part of an annual or semiannual physical examination. Nutrient-poor diets or those that feature soft foods are associated with a higher incidence of tartar and gingivitis than nutritionally balanced diets that contain hard foods. Diets with hard foods, such as dog kibble and monkey biscuits, may wear down teeth over a kinkajou's long life (see **Fig. 4**).

FINAL THOUGHTS

Kinkajous are not suitable pets for most people, because the species takes considerable resources to accommodate their needs. They are often overlooked in zoo collections and in field research, because they are not considered threatened or endangered. The authors have presented an overview of the diets and enrichment

Fig. 7. This obese kinkajou has rolls of fat. It is approximately 200% heavier than it should be for a body condition score of 3. (*Courtesy of* D. Eshar, DVM, Philadelphia, PA.)

methods that sustain reproduction, growth, and longevity in captive kinkajous. It is important, however, to recognize that kinkajous' nutritional needs are as poorly understood as almost everything else about their natural history.

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