

Companion Animals: Comparative Animal Biology

174 Diet transition time and stabilization of apparent digestibility in the feline. S. K. Martin*¹, M. R. C. de Godoy¹, D. L. Harmon¹, E. S. Vanzant¹, R. M. Yamka², K. G. Friesen², and K. R. McLeod¹, ¹University of Kentucky, Lexington, ²Hill's Pet Nutrition, Inc., Topeka, KS.

An experiment was conducted to determine the effects of length of dietary adaptation time on apparent nutrient digestibility in felines. Ten adult female shorthair cats were used to evaluate nutrient digestibility of 2 extruded dry test foods; differing only in inert marker included (Cr and Ti). Each experimental period (n=5/diet) consisted of 7 d adaptation and 21 d of total fecal and urine collection. Prior to each experimental period, cats were fed an extruded dry maintenance food for at least 3 wks. In comparison to the maintenance food, test foods were designed to have differing nutritional profiles with lower amounts of protein (29.7 vs. 33.7%) and fat (20.2 vs. 24.3%) and higher amounts of total dietary fiber (8.5 vs. 3.0%), and differences in ingredient composition. Foods were fed to meet maintenance energy requirements for adult cats. Dietary transition was conducted by incrementally increasing the proportion of test food by 25% on d 1, 3, 5, and 7 of each period. Fecal and urine samples were collected daily. Cats did not produce fecal samples on a daily basis, and accordingly samples were composited by week. Data were analyzed as a crossover design with repeated measures over time. Across test foods, dry matter digestibility (DMD) was unaffected (P = 0.86) by adaptation time; averaging 79.7, 80.1, 80.3% for wk 1, 2, and 3 respectively. Coefficients of variation were 4.07, 3.37, 4.78% for wk 1, 2, and 3 respectively. Similarly, nitrogen digestibility (ND) was unaffected (P = 0.61) by time, averaging 80.7, 81.5, 81.7% for wk 1, 2, and 3, respectively. Coefficients of variation were 4.32, 2.84, 3.58% for wk 1, 2, and 3 respectively. Results indicate that 7-d food adaptation period is satisfactory for apparent total tract nutrient digestibility stabilization in cats undergoing transition between dry extruded foods.

Key Words: Cat, Digestibility, Food Adaptation

175 Low-level fructan supplementation is effective in modifying stool protein catabolite concentrations but not gut microbiota populations in adult dogs. K. Barry*¹, D. Hernot¹, I. Middelbos¹, C. Francis², B. Dunsford², and G. Fahey, Jr.¹, ¹University of Illinois, Urbana, ²GTC Nutrition, Golden, CO.

Five ileal-cannulated adult dogs were utilized in a 5 x 5 Latin square design to determine the effects of fructan type and concentration on nutrient digestibility, stool protein catabolite concentrations, and microbiota in ileal digesta and feces. Five diets were evaluated that contained either cellulose alone or with inulin or short-chain fructooligosaccharides (scFOS) at 0.2 or 0.4% of the diet. Dogs were fed 175 g of their assigned diet twice daily. Chromic oxide served as a digestibility marker. Nutrient digestibility; ileal and fecal pH, ammonia concentrations, short- and branched-chain fatty acid concentrations, and microbial populations; ileal IgA concentrations; and fecal concentrations of phenols, indoles, and biogenic amines were measured. No differences were observed in ileal pH or concentrations of ammonia, acetate, or isobutyrate, or fecal concentrations of indole or valerate. Ileal dry matter (DM), organic matter (OM), and crude protein (CP) digestibilities; total tract DM and OM digestibilities; fecal concentrations of phenylethylamine; and

ileal concentrations of *E. coli* increased linearly (P<0.05) with inulin supplementation and fecal concentrations of phenol decreased linearly (P<0.05). Fecal concentrations of acetate and propionate decreased quadratically (P<0.05) with inulin supplementation. Ileal DM, OM, and CP digestibilities increased linearly (P<0.05) with scFOS supplementation and fecal concentrations of phenol decreased linearly (P<0.05). Total tract DM and OM digestibilities; ileal butyrate concentrations; fecal p-cresol, butyrate, and isobutyrate concentrations; and ileal Clostridium perfringens concentrations increased quadratically (P<0.05) with scFOS supplementation. Both supplemental fructans modified stool protein catabolites, but scFOS appeared to result in more significant modifications than did inulin. While a higher level of inclusion would be recommended to modify gut microbiota populations, low-level inclusion of either fructan is effective in modifying stool protein catabolite concentrations in the terminal ileum and feces of adult dogs.

Key Words: Fructan, Dog, Protein Catabolite

176 Influence of dietary protein content and source on digestibility patterns, osmolality and fecal quality in dogs differing in body size. J. Nery*¹, C. Tournier², V. Biourge², L. Martin¹, H. Dumon¹, and P. Nguyen¹, ¹Ecole Nationale Veterinaire de Nantes, Nantes, France, ²Royal Canin, Aimargues, France.

Large breed dogs are known to be more sensitive to diet than smaller ones and consequently to produce feces of poorer quality. A higher overall total apparent digestibility was previously associated to higher fermentation rates and higher luminal osmolality, in the colon of large breed dogs. The use of highly digestible protein and a reduction of crude protein (CP) level could constitute a solution to decrease colonic osmolality and improve large dog's fecal quality. The aim of this study was to assess the effect of protein source and level on total digestibility, osmolality and fecal quality in dogs differing in body size.

27 healthy female dogs were divided in 4 groups according to body weight and propensity to produce soft feces. Five diets varying in protein source (wheat gluten and/or poultry meal) and level (20%, 28% and 36% CP as fed) were tested. Feces were collected and scored on a daily basis during a 7-day test period preceded by a 7-day adaptation period. Moisture, and apparent digestibility coefficients (ADC) of DM, energy, fat, CP and ash, were determined from the feces collection pool. Osmolality was analysed from freshly voided feces. Data were analyzed using Kruskal-Wallis nonparametric test and Bonferroni/Dunn post-hoc test.

Fecal quality decreased with dog size (p<0.0001) and was lower for poultry meal diets (p<0.0001). ADC increased with dog size, was lower when poultry meal was the major protein source and varied inversely to dietary protein level. Fecal osmolality varied with source (p<0.001) but not with CP content of diet, being higher for poultry diets. No effect of dog size was found for this parameter.

Conclusions: Protein source has proven to be a good mean to modulate fecal quality in sensitive dogs due to its effect on digestibility and fecal osmolality. Conversely differences of fecal quality between different dog's size and levels of CP fed do not seem to be related with fecal osmolality.

Key Words: Fecal Quality, Dog, Osmolality

177 Evaluation of high protein diets in kittens during their first year of life. B. M. Vester^{*1}, K. J. Liu², T. L. Keel¹, T. K. Graves¹, and K. S. Swanson¹, ¹University of Illinois, Urbana, ²Natura Manufacturing, Inc., Fremont, NE.

Diets containing high concentrations of protein are now available on the mass market for cats. The objective of this experiment was to evaluate cats through their first year of life while being fed either a high(HP)- or moderate-protein(MP) diet. Eight dams were randomized onto 1 of the 2 test diets (53 and 34% protein, respectively). These dams were fed the diets for 1 mo prior to mating, and were all mated to 1 male. Upon queening, the male offspring were evaluated for 14 mo. All kittens were weaned at 8 wk of age onto the same treatment diet as the dam and were allowed to consume ad libitum throughout the study. Food intake and refusals were measured daily. Kittens were housed by litter from wk 8 to 16 then pair housed by diet. Blood samples were collected at 6 mo, and 12 mo after birth and analyzed for glucose, leptin, insulin, NEFAs, and triglycerides. Body composition using DEXA was determined at 8 wk, 8 mo, and 14 mo of age and an intravenous glucose tolerance test was conducted at 8 mo and 14 mo of age. Kittens were castrated and an adipose biopsy taken at 8 mo of age. Activity was quantified using Actical monitors at 6, 9, and 12 mo of age. Dry matter intake and body weight were not different between the 2 diet groups. Leptin did not differ between diets, but increased ($P<0.05$) over time from 6 mo to 12 mo of age. NEFAs were highest ($P<0.05$) at 6 mo of age and tended to be higher ($P<0.10$) in kittens fed the HP diet. Triglycerides were increased ($P<0.05$) in kittens fed the HP diet at 8 wk of age, but were not different at 6 mo or 12 mo. Activity was not affected by diet, but activity during the light period tended to decrease ($P<0.10$) as the cats aged. Kittens fed the HP diet tended to have increased ($P<0.10$) grams of lean mass compared to kittens fed the MP diet. Glucose area under the curve (AUC) was decreased ($P<0.05$) at 14 mo compared to 8 mo, but was not affected by diet. Insulin AUC was higher ($P<0.05$) in kittens fed the HP diet compared to the kittens fed the MP diet at 14 mo of age. Based on indices measured in this study, a HP versus MP diet appears to be a suitable replacement to the carbohydrate-based diets mass marketed to feline owners.

Key Words: Cat

178 Influence of feeding raw or extruded feline diets on nutrient digestibility and nitrogen metabolism in African wildcats. B. M. Vester^{*1}, S. L. Burke², K. J. Liu³, C. L. Dikeman², L. G. Simmons², and K. S. Swanson¹, ¹University of Illinois, Urbana, ²Henry Doorly Zoo, Omaha, NE, ³Natura Manufacturing, Inc., Fremont, NE.

The African wildcat is one of the closest ancestors to the domestic cat and is believed to have similar nutrient requirements to domestic felids, but research is lacking. Small exotic cats housed in captivity are often fed a raw meat-based diet, which poses a risk of bacterial contamination. The objective of this experiment was to determine the effects of feeding a high protein extruded kibble diet versus a raw meat diet on nutrient digestibility, nitrogen balance, and blood metabolite concentrations in African wildcats. Five African wildcats were randomized onto either a high-protein extruded kibble diet or a raw meat carnivore diet. The study was executed as a crossover design, consisting of 21 d periods, with a 16 d adaptation phase, a 4 d fecal and urine collection phase, and

1 d for blood collection. Cats were housed individually in metabolism cages and fed to maintain body weight. Food offered and refused was measured daily. Both fresh and acidified urine was collected during the 4 d collection period for urinalysis and nitrogen measurement. A fresh fecal sample was collected for short chain- and branched chain- fatty acid analysis. Blood was analyzed for serum chemistry and leptin. Overall, both diets appeared to be well digested by the cats. Protein digestibility was higher ($P<0.05$) when cats were fed the raw meat diet versus the kibble. Nitrogen balance was positive for both diets (1.95 kibble diet versus 0.76 raw meat diet) and mirrored body weight changes (baseline 3.4 kg, kibble 3.6 kg, and raw meat 3.4 kg). Fecal propionate concentrations tended to be higher ($P<0.10$) when cats were fed the raw meat diet, however, fecal butyrate concentrations tended to be higher when cats were fed the kibble diet. Blood analysis showed few differences between diets, but alanine aminotransferase activity was higher ($P<0.05$) when cats were fed the raw meat diet. These data indicate that feeding an extruded kibble diet to African wildcats appears to be a suitable replacement to a raw meat diet.

Key Words: African Wildcat, Raw

179 Vitamin and mineral comparisons between captive and free-ranging koalas (*Phascolarctos cinereus*), possible explanations for hip dysplasia. D. A. Schmidt^{*1}, W. A. Ellis^{1,2}, F. B. Bercovitch¹, Z. Lu³, T. C. Chen³, C. Hamlin-Andrus¹, G. W. Pye¹, and M. F. Holick³, ¹Zoological Society of San Diego, San Diego, CA, ²University of Queensland, Brisbane, Australia, ³Vitamin D, Skin and Bone Laboratory, Boston University School of Medicine, Boston, MA.

A retrospective/prospective study of koalas (*Phascolarctos cinereus*) bred at the San Diego Zoo has documented 55 cases of moderate to severe hip dysplasia, with varying degrees of bone malformation. While the cause of the dysplasia is likely genetic, abnormal bone development due to insufficient concentrations of vitamin D for calcium absorption needed investigation. Most koalas housed at the San Diego Zoo are managed indoors without access to direct, unfiltered sunlight. Zoo koalas only consume eucalyptus leaves and few plants have significant concentrations of vitamin D₂ and D₃. Serum samples from 22 zoo and 19 free-ranging koalas were analyzed for Ca, Cl, Co, Cu, Fe, Mg, Mn, Mo, P, K, Se, Na, Zn, and vitamins A, D, and E. Zoo and free-ranging koalas and males and females were compared using student's t-tests ($P\leq0.05$). No differences were found between genders within the zoo population. Calcium concentrations were different between zoo and wild koalas, averaging 10.7 and 10.3 mg/dL, respectively. However, these concentrations are considered within the normal range for other species. Chloride and Se concentrations were also higher in zoo koalas than in wild koalas, while P and Zn concentrations were higher in the wild animals. Although Mo concentrations averaged 4.8 ng/ml in captive koalas, concentrations were not detectable in the free-ranging population. Manganese concentrations ranged from not detectable to 2.5 ng/ml for captive koalas, but averaged 11.09 ng/ml for the free-ranging animals. Vitamin D (25-hydroxyvitamin D₂ and D₃) was analyzed using an RIA kit for humans. Concentrations were detected in the captive koalas with results near the minimal functional detectable limits of the assay. The free-ranging koalas had no detectable serum concentrations of vitamin D₃, raising concerns about the validity of the test in this species.

Key Words: Koala, Vitamin, Mineral

180 Using regression analysis to determine the quantities of browse component dry matter on branches of Carolina willow (*Salix caroliniana*). M. L. Schlegel^{1,2}, A. McComb^{2,3}, and E. V. Valdes², ¹The Zoological Society of San Diego, San Diego, CA, ²Disney's Animal Programs, Lake Buena Vista, FL, ³North Carolina State University, Raleigh.

One challenge in determining browse intake of zoo animals is quantifying the initial component composition. Depending on the animal species, animals will consume not only the leaves, but also the stems, bark, and wood. The objective of this project was to determine the relationship between branch diameter and the quantity of browse component DM on branches of Carolina willow (*Salix caroliniana*). Eighteen branches of willow were harvested in central Florida between April and May, weighed wet (range = 0.05 to 2.9 kg), and the base branch diameter measured (range = 7.75 to 42.25 mm) using calipers. Each branch was separated into five components (leaves, green stems, woody stems < 0.5 cm in diameter, bark from stems > 0.5 cm in diameter, and wood from stems > 0.5 cm in diameter). Components were dried at 55 °C to determine quantity of DM and to calculate total branch DM. Regression analysis of branch diameter versus branch component DM and total branch DM was done using Microsoft Excel. All prediction equations (branch component DM, g = diameter coefficient × branch diameter, mm + intercept) contained significant ($P < 0.05$) regression coefficients (Table 1). Using these predictive regression equations, the quantity of DM offered from each browse component can be estimated and the quantity of browse consumed determined when the browse components refused are separated and dried. Although this set of predictive equations is useful for Carolina willow only, the concept can be applied to other browse species fed.

Table 1. Regression coefficients to predict Carolina willow (*Salix caroliniana*) branch component DM (g) based on branch diameter (mm)

Branch Component	Coefficients				
	Intercept	SE	Diameter	SE	r ²
Leaves	-55.20	18.75	5.92	0.93	0.70
Green stems	-16.77	5.88	1.86	0.29	0.70
Woody stems < 0.5 cm in diameter	-22.37	3.48	2.33	0.17	0.91
Bark from stems > 0.5 cm in diameter	-69.69	10.42	6.19	0.52	0.89
Wood from stems > 0.5 cm in diameter	-186.82	27.23	16.20	1.35	0.89
Total branch	-350.86	52.24	32.50	2.59	0.90

Key Words: Willow, Browse, Composition

181 An epidemiological study into the effect of captive diets on reproductive success in Humboldt and African penguins. R. McClements^{1,3}, K. Slifka², and A. Ward³, ¹University of Sydney, Camperdown, NSW, Australia, ²Dallas Zoo and Aquarium, Dallas, TX, ³Zoo Nutrition Services, Fort Worth, TX.

Captive breeding of exotic avian species for conservation and species management programs have received considerable attention in recent years. These programs promote self-sustaining populations, however production is often less successful than anticipated. Reproductive success among institutions holding African (*Spheniscus demersus*) and Humboldt (*Spheniscus humboldti*) penguins varies considerably, thus it was the aim of the experiment to determine whether nutrition was a factor. Commencing in 2003, a two-year epidemiological study was conducted through the collection of fish, eggs, and reproductive histories from sixteen institutions holding a minimum of six penguins. Fish and egg samples were analyzed for fatty acids and fat soluble vitamins and the results correlated with historical success. The most significant finding was higher concentrations of linoleic acid in the eggs from the institutions with the best reproductive success ($8.55 \pm 0.45 \mu\text{g/g}$) compared to those with only moderate success ($1.43 \pm 0.44 \mu\text{g/g}$). The increase in linoleic acid resulted in the ω -3 to ω -6 fatty acid ratios becoming similar to those observed in the eggs of free-ranging piscivorous and carnivorous birds. Additionally, all eggs contained relatively high concentrations of α -tocopherol ($175.7 - 353.0 \mu\text{g/g}$). These concentrations were considerably higher than previously observed in free-ranging piscivorous species, suggesting that the dietary supplementation resulted in egg concentrations higher than probable needs. These data suggest nutrition may be a factor in the lower reproductive success among institutions, however determining the magnitude and effect of these differences require a subsequent controlled study.

Key Words: Captive Breeding, Fatty Acids, Fat Soluble Vitamins