Evaluation of cats fed vegetarian diets and attitudes of their caregivers

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Objective—To determine motivation and feeding practices of people who feed their cats vegetarian diets as well as taurine and cobalamin status of cats consuming vegetarian diets.

Design—Cross-sectional study.

Animals—34 cats that had been exclusively fed a commercial or homemade vegetarian diet and 52 cats that had been fed a conventional diet for ≥ 1 year.

Procedures—Participants were recruited through a Web site and from attendees of a national animal welfare conference. Caregivers of cats in both groups answered a telephone questionnaire regarding feeding practices for their cats. Blood was obtained from a subset of cats that had been fed vegetarian diets. Blood and plasma taurine and serum cobalamin concentrations were measured.

Results—People who fed vegetarian diets to their cats did so largely for ethical considerations and were more likely than people who fed conventional diets to believe that there are health benefits associated with a vegetarian diet and that conventional commercial cat foods are unwholesome. Both groups were aware of the potential health problems that could arise from improperly formulated vegetarian diets. All cats evaluated had serum cobalamin concentrations within reference range, and 14 of 17 had blood taurine concentrations within reference range.

Conclusions and Clinical Relevance—Vegetarian diets are fed to cats primarily for ethical considerations. Results of this study should aid practitioners in communicating with and providing advice to such clients. (*J Am Vet Med Assoc* 2006;229:70–73)

Vegetarianism has become increasingly popular in the United States. Individuals choose a vegetarian lifestyle for various reasons such as ethical, health, or religious considerations or taste preference. It is well-known that cats are obligate carnivores (ie, some of their required nutrients are only found naturally in animal sources). Despite this fact, some people feed their cats a vegetarian diet. Commercially prepared vegetarian cat foods, home-prepared diets, and supplements can be added to or replace standard commercial diets. Such products and recipes, along with related information, are often found on the Internet. Presently, in the United States, there are 2 cat food product manufacturers that exclude all animal-derived ingredients, including dairy, from their products. These foods are formulated to meet the AAFCO Cat Food Nutrient Profiles. The manufacturers use the formulation method rather than an AAFCO protocol feeding trial to substantiate claims of nutritional adequacy.

Abbreviations

AAFCO	Association of American Feed Control Officials
LUTD	Lower urinary tract disease

Several studies have called into question the nutritional adequacy of a vegetarian diet for cats. A 2004 study[1] found that 2 commercially available vegetarian cat foods failed to meet AAFCO Cat Food Nutrient Profiles on the basis of nutritional analysis. Both diets were deficient in taurine and arachidonic acid, and 1 was also deficient in vitamin A.[1] In the literature is a published abstract as well as a case report of nutritional deficiencies in cats fed vegetarian diets.[2,a] Diets other than those found deficient in the 2004 study[1] had been fed to the cats in these 2 earlier reports.[2,a]

The purpose of the study reported here was to determine motivation and feeding practices of people who feed their cats vegetarian diets as well as taurine and cobalamin status of cats consuming vegetarian diets.

Materials and Methods

Study participants were recruited through a Web site created specifically for recruitment purposes.[3] The Web site shared reciprocal links with other sites, including sites promoting vegetarian lifestyles (for humans as well as companion animals) and animal welfare. Attendees of a national animal welfare conference were also recruited for participation in the study.[b] The study underwent institutional review and approval.

Two groups of cats and their caregivers from households in which cats were exclusively fed a commercial or homemade vegetarian diet for ≥ 1 year (group V) and from households in which cats were exclusively fed a conventional feline diet for ≥ 1 year (group C) were investigated. All cats were required to have a veterinary practice of record and to have been evaluated at least once at that practice over the course of 1 year. Only 1 cat per household was included, and all participants had to reside in the United States. For multiple-cat households, the caregiver was instructed to respond about the oldest cat.

A telephone questionnaire was developed to gather information about the feeding practices and motivation of people who chose to feed their cats vegetarian diets. The questionnaire collected information about signalment, housing (including whether there were other pets in the household and whether the study cat was permitted outdoors), body condition, details of the diet including any supplements or treats fed, and the caregiver's perception of the cat's health status. With regard to feeding a vegetarian diet, the caregivers were asked why they had made this choice, whether they were aware of any health benefits or risks of such a diet,

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whether their veterinarian was aware of this practice and what his or her reaction was, and whether they had any concerns regarding conventional pet foods. Caregivers from group C were given a similar telephone interview; questions on the specifics of the vegetarian diet fed were omitted. Possible responses to each question, including "other," had been predetermined for ease of recording during the interview, although these were never read to the respondents. If participants had more than 1 response to a question they were asked to rank their responses and answer with the response to which they attributed the greatest importance.

People who had either been feeding their cats a commercially available complete vegetarian diet[c] or a home-prepared complete diet made with a commercially available supplement[d] for a minimum of 1 year were recruited from the survey population. They were asked to give informed consent to allow blood collection from their cats after withholding of food for 12 hours to determine blood and plasma taurine concentrations and serum cobalamin (B_{12}) concentration. Cats that had been fed a diet formulated by their caregivers were excluded because of the likelihood that those diets would not meet AAFCO requirements. Taurine and cobalamin status were selected for evaluation because they are nutrients lacking in a vegetarian diet and because assays that have been validated in cats were available. Also, taurine and cobalamin blood values reasonably reflect total-body status. Venipuncture was performed by the cats' attending veterinarians, and samples were submitted according to reference laboratory specifications.[e,f] The results were compared with the reference intervals established by the reporting laboratories.

Statistical analysis—χ^2 Analysis or the Fisher exact test was used, as appropriate, to test for differences in variables between cats from groups V and C for categoric variables. Student *t* tests were used to compare age of the cats and time the particular diets had been fed between groups. A value of $P < 0.05$ was considered significant. All analyses were performed with statistical software.[g]

Results

Caregivers of 34 cats that met the inclusion criteria for group V and 52 that met the criteria for group C agreed to participate in the survey. All but 2 of the survey respondents (both in group C) were vegetarians themselves. No significant differences in age, sex, body condition, housing, or perceived health status existed between cats from the 2 groups (**Table 1**). Most of the respondents in both groups described their pets as healthy or generally healthy.

The majority of group V (66%) fed their cats a commercially available vegetarian diet[c] exclusively; the rest of the group fed either a combination of the commercially available diet and home-prepared food or exclusively home-prepared food. All but 2 of the group V respondents who fed home-prepared food used a commercially available supplement[d] and followed one of the recipes that came with that supplement. Group V were more likely than group C to have obtained dietary information from the Internet (53% vs 6%, respectively; $P < 0.001$) or books and magazines (24% vs 6%, respectively; $P < 0.001$). No difference was detected between groups regarding the use of vitamin, mineral, or other dietary supplements.

Eighty-two percent of group V stated they chose their cat's diet out of ethical concerns, whereas group C stated various reasons, including health benefits, convenience, lack of information regarding vegetarian diets, or their cats' preference, for choosing a conventional feline diet (**Table 2**). When asked whether they were aware of any health benefits associated with feeding a cat a vegetarian diet, 88% of group V responded affirmatively, as opposed to 44% of group C ($P < 0.001$). The most common benefits cited by group V were avoiding harmful substances in conventional pet food, less risk of cancer, and a healthier coat. When asked whether they were aware of any potential health risks associated with feeding a vegetarian diet, 79% of group V and 69% of group C responded yes ($P = 0.33$). Similar percentages of both groups (group V, 36%; group C, 33%) were aware of the risk of taurine deficiency and its consequences; however, group V perceived a greater risk of urolithiasis and LUTD (26%), compared with group C (4%).

When the survey respondents in group V were asked whether their veterinarian knew that they were

Table 2—Percentages of responses from cat owners who chose to feed their cat a vegetarian diet or a conventional diet.

Variable	Group V	Group C
Reasons for diet choice		
Convenience	0	25
Ethical considerations	82	0
Health benefits	9	29
Other	9	46
Perceived health benefits of a feline vegetarian diet		
Avoid commercial food	26	15
Decreased risk of cancer	15	0
Healthy coat	9	0
Longevity	3	4
Weight control	3	6
Reduced risk of allergies	3	0
None	12	56
Unspecified/other	30	19
Perceived health risks of a feline vegetarian diet		
Retinal atrophy	9	2
Taurine deficiency	18	31
LUTD	26	4
Protein deficiency	6	4
Dilated cardiomyopathy	6	0
No health issues	21	31
Unspecified/other	15	29

Table 1—Demographic variables of 34 cats fed a vegetarian diet (group V) and 52 cats fed a conventional diet (group C).

Variable	Group V	Group C	*P* value
Age (mean ± SD)	7.0 ± 4.7	7.8 ± 4.8	0.48
No. of years diet fed (mean ± SD)	4.6 ± 4.1	6.5 ± 4.7	0.06
Sex distribution (SF;CM [%])	38;62	56;44	0.13
Kept strictly indoors (%)	65	69	0.80
Reported to be in ideal body condition (%)	82	65	0.17
Reported to be healthy or generally healthy (%)	97	96	0.38

SF = Spayed female. CM = Castrated male.

feeding their cat a vegetarian diet, 76% said yes, 15% said no, and 9% were unsure whether their veterinarian knew. Of the respondents who had told their veterinarian about their practices, 26% reported that their veterinarian was completely against it; 11% reported that their veterinarian was completely supportive; and another 37% reported that their veterinarian had requested more information about the diet, suggested monitoring their cat's blood values, or suggested having the diet analyzed.

Regarding concerns about commercial pet food, 79% of group V believed it was unsafe or unhealthy, compared with 51% of group C ($P = 0.04$). A greater percentage of group C (37%) than group V (21%) stated ethical concerns about commercial pet foods ($P = 0.04$).

Blood was obtained from 17 cats. Mean ± SD age of the cats in this subset of group V was 6.6 ± 4.4 years, and they had been fed a vegetarian diet for 4.4 ± 3.4 years. Seventy-six percent of the cats were kept strictly indoors, 76% were reported to be in ideal body condition, and 94% were reported to be in good health. Forty-seven percent of the cats were fed a commercially available diet,[c] 12% were fed food prepared with a commercially available supplement,[d] and 41% were fed a combination of the 2 components. In 2 instances, plasma was not submitted; therefore, plasma taurine concentrations were available for only 15 of 17 cats. Mean plasma taurine concentration was 119 ± 41 nmol/mL (median, 114 nmol/mL; range, 52 to 188 nmol/mL; reference range, 60 to 120 nmol/mL). Only 1 sample yielded a value less than the reference range, and no values were less than the critical concentration of 40 nmol/mL. Mean blood taurine concentration was 388 ± 117 nmol/mL (median, 364 nmol/mL; range, 224 to 672 nmol/mL; reference range, 300 to 600 nmol/mL). Three cats had a value less than the reference range, but those values were greater than the critical concentration of 200 nmol/L. Serum cobalamin concentration for all cats was within reference range (mean, 873 ± 326 ng/L; median, 1,005 ng/L; range, 299 to 1,201 ng/L; reference range, 290 to 1,499 ng/L).

Discussion

People who fed vegetarian diets to their cats did so largely for ethical considerations. They were also more likely than people who fed conventional diets to believe that there are health benefits associated with a feline vegetarian diet and that conventional commercial cat foods are unwholesome. People who fed vegetarian diets and those who fed conventional cat foods were aware of the potential health problems that could arise from an improperly formulated vegetarian diet.

Most caregivers in group V recognized the possibility of health risks associated with feeding cats a vegetarian diet. For instance, many were aware of the risk of their cat developing taurine deficiency, and presumably selected the diet they fed because it was labeled as having a taurine supplement. In addition to taurine deficiency, 26% of group V perceived that a cat was at increased risk of developing urolithiasis or LUTD from eating a vegetarian diet. This increased risk of urolithiasis and LUTD is anecdotal only, and to the authors' knowledge has not been documented in any studies or case reports. Presumably, the concern is that a vegetarian diet could lead to production of alkaline urine and increase the risk of struvite formation.

Most of group V reported that their pet's veterinarian knew that they were feeding their cat a vegetarian diet. Regarding the veterinarians who were unaware of the pet's diet, it was unknown whether this was because they did not ask or because caregivers purposely did not offer this information. If they failed to discuss their cat's diet with their veterinarian, it may have been on the presumption that the practice of feeding vegetarian diets to cats is generally frowned upon by the veterinary profession (only 11% of attending veterinarians were characterized as completely supportive of the feeding practice).

Although the actual percentage of cats fed vegetarian diets in the United States is presently unknown, we presume that it is low. Consequently, the means used to recruit participants for the study targeted this small population of caregivers who feed their cats vegetarian diets. Furthermore, the questionnaire was straightforward in addressing the subject. Participants were not randomly selected; rather, they learned of the investigation on their own accord and volunteered to participate. Thus, there was a likelihood of bias because of the participants' self-selection. Use of the Internet, conference attendance, and cost of food may have selected people with a certain educational background and economic status. Therefore, results may not have been entirely representative of people who feed vegetarian diets to their cats.

It is well recognized that vegetarian cats are at risk of developing taurine deficiency.[4] Taurine deficiency can cause dilated cardiomyopathy and retinal degeneration.[4] Blood taurine concentration is a better indicator of tissue status than is plasma taurine concentration.[5] Therefore, a reduction in blood taurine concentration is considered a marker of long-term deficiency. Cats are considered taurine deficient if blood concentrations are consistently < 200 nmol/mL.[e] Plasma taurine concentration can vary because of acute deficiencies in intake, such as food deprivation, or because of sample handling issues such as hemolysis or inclusion of platelets.[5] Plasma taurine concentrations < 40 nmol/mL have been associated with clinical signs of taurine deficiency.[5]

Blood taurine concentrations were within reference range for most of the cats tested. However, 3 cats had blood taurine concentrations between the reference range and the critical concentration, suggesting that their dietary intake was marginal, but that they were not clinically deficient. Possible explanations for this include variation in cats' individual diets, such as the addition of table scraps and treats (all 3 received either or both), and potential quality assurance issues affecting manufacture of the diets. The manufacturers of these diets are small companies that make individual batches as needed. All 3 cats with blood taurine concentrations < 300 nmol/mL were kept strictly indoors, did not receive vitamin supplements, and were reported as healthy by the caregivers. The lifestyle of these cats did not appear to be different from that of the cats with blood taurine concentrations within the reference range. One cat had a plasma

taurine concentration between reference range and the critical concentration. Considering that this cat's blood taurine concentration was in the upper portion of the reference range, this finding was likely indicative of a short-term deficiency rather than tissue depletion, in which concurrent blood taurine concentration should be low. In light of the study by Gray et al,[1] it was surprising that no cats had concurrent low plasma and blood taurine concentrations. That investigation found that the concentrations of taurine in both of the vegetarian diets consumed by the cats in the present study were less than the AAFCO minimum for taurine.[1,c,d]

Cobalamin functions as a coenzyme, and deficiencies in this nutrient can cause neuropathies, anemia, and poor growth.[6] Low serum cobalamin concentration (≤ 100 ng/L) indicates cellular cobalamin deficiency.[7] Cobalamin can only be obtained from animal sources or fermented foods; therefore, it must be added as a supplement in vegetarian cat foods. It has been reported that one of the diets[c] used by the caregivers in the present study was slightly deficient in cobalamin.[1] Serum cobalamin concentrations for all of the cats in our study were within reference range, which indicates that these cats had sufficient dietary cobalamin to maintain adequate serum values and that their cellular cobalamin concentrations were adequate.[7] Lack of an appropriate assay was the reason that nutrients of concern in vegetarian cats other than taurine and cobalamin, such as arachidonic acid or retinol (vitamin A), were not evaluated. In future investigations, it would be worthwhile to assess how long-term maintenance of cats on a proven nutritionally complete vegetarian diet affects their health and nutritional status.

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