A High-Fiber Food Improves Weight Loss Compared to a High-Protein, High-Fat Food in Pet Dogs in a Home Setting

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ABSTRACT

Little is known about the relative effectiveness of different weight loss foods for pet dogs in the home setting. Here, we performed a randomized, blinded, 24-week prospective study in 73 client-owned adult dogs to compare weight loss in the home setting using an energy-dense high-protein/high-fat food (HP/HF) or a lower density high-fiber food (HFIB). Investigators recommended amounts of food according to the resting energy requirement for the dog's ideal body weight and a target of 2% weight loss per week. Every 4 weeks, investigators measured body weight, and every week, owners recorded the amount of food dispensed and whether their dog consumed all that was offered. In dogs completing the study according to protocol, those fed HFIB (n=32) lost more weight (P=0.009) than those fed HP/HF (n=30). Sex, clinic, initial weight, amount of energy offered by owners, and frequency of eating all the food offered were not significant factors. According to owners' records, there was no difference in the amount of energy offered to the two groups or in the frequency of supplementary energy intake, frequency of vomiting, or stool quality. In summary, in the home setting, a high-fiber food is more effective than a high-protein/high-fat food for weight loss in obese pet dogs.

INTRODUCTION

According to recent estimates, 20% to 40% of dogs are obese,[1] and the incidence appears to be increasing.[2] Decreasing the number of calories consumed is the principal strategy for weight loss in overweight dogs.[3] However, simply feeding dogs less of their usual food may result in insufficient nutrient intake because most commercial foods balance non-energy nutrients relative to energy.

Therefore, therapeutic dog foods manufactured for weight reduction are recommended in place of simply restricting access to the dog's usual food. Such therapeutic dog foods generally include proportional increases in protein, vitamins, and minerals relative to energy to allow energy restriction without nutrient deficiencies while minimizing muscle loss.[2] They may also include increased fiber, which has been reported in some studies to be effective at promoting weight loss in pet dogs,[4,5] although other studies have failed to show a benefit of increased fiber.[6,7]

Here, we performed a randomized, blinded, prospective 24-week study to compare weight loss by pet dogs in the home setting using two therapeutic foods. The first food was designed to be a relatively calorie-dense food with high protein and high fat (HP/HF), similar to the Atkins approach, which has been effective for weight loss in humans. [8] The second was a relatively high-fiber, low-fat food (HFIB), similar to some typical canine weight loss foods. [9] The study was designed to provide dogs in both groups with equal amounts of energy from the study foods.

MATERIALS AND METHODS

Study Population

This was a prospective, multicenter, randomized, blinded, 24-week study in pet dogs conducted between August 2, 2004, and March 28, 2005. The study was approved by Hill's Institutional Animal Care and Use Committee. All dogs were cared for in accordance with the sponsor's animal care and use protocols and in accordance with the general principles of Good Clinical Practice, and all pet owners gave written informed consent.

Dogs were recruited from 12 private veterinary hospitals in the United States. Dogs had to be at least 1 year old. In addition, according to investigators (primary care veterinarians), dogs had to have a body condition score (BCS) of 4 or 5 on a 5-point scale, where 1 indicates thin, 2 underweight, 3 ideal, 4 overweight, and 5 obese. [10]

Dogs also had to be free of any systemic disease as determined by history, physical examination, complete blood count, serum biochemistry analysis, and urinalysis. Results of laboratory tests were required to be within reference ranges provided by the analytical testing facility or to be acceptable according to the investigator's clinical assessment.

Fractious dogs and those that were pregnant or likely to become pregnant during the study were excluded. Dogs receiving concurrent medications were excluded, and concurrent medications were not allowed during the course of the study. Dogs were dismissed during the course of the study if they required care that necessitated unmasking of the test food, the veterinary investigator became unmasked, the dog owner did not comply with study conditions, or the dog was lost to follow-up, died, or was euthanized.

Study Foods

Two foods with increased nutrient density were developed for this study: HP/HF was formulated to have relatively low carbohydrates, high protein, and high fat, whereas HFIB (Prescription Diet r/d, Hill's Pet Nutrition Inc., Topeka, KS) was formulated to have high fiber and low fat. Both foods were available in wet (canned) and dry forms. The amount of metabolizable energy in the foods was estimated based on digestibility measurements,[11] and nutritional contents of the foods were estimated using standard methods by Eurofins (Des Moines, IA). All foods met the American Association of Feed Control Officials dog nutrient minimum and maximum recommendations for adult maintenance.

Study Conduct and Assessments

Dogs were housed with their owners during the course of the study. Dogs meeting inclusion criteria were sequentially enrolled and randomized to receive HP/HF or HFIB. Both the investigator and the owner were blinded to which food the dog was to receive. Owners had the choice of feeding dry food, wet food, or a combination of both.

Owners were instructed to feed dogs according to the resting energy requirement, which was calculated as follows: resting energy requirement (kcal) = 70 x (ideal body weight in kg) $^{0.75}$,[12] where the ideal body weight was estimated by the investigator. Pet owners gradually transitioned the dogs from their previous food to the study food over 1 week (week 0), and then fed the assigned food for 24 weeks (weeks 1 to 24) or until the dog attained an ideal body weight (BCS = 3).

Every 4 weeks, dogs were seen by investigators in their offices, where they performed a general physical examination of the dog and recorded its body weight and BCS. Every week, owners completed a log assessing the following: amount of dry food (in cups) or wet food (in cans) offered; whether their dog ate all of the dry food offered; whether dogs ate all of the wet food offered; episodes of consuming items other than the study foods; stool appearance; and number of episodes of vomiting. Adverse events were recorded within 24 hr by the investigator, including the severity and relationship to the study food.

Statistical Analysis

All analyses were performed using SAS version 9.1.3 (SAS Institute Inc, Cary, NC). The percent of weight change from the start of the study (week 0), differences between the two foods and over time in the daily feeding recommendations, and the reported amount of energy offered by the pet owners per day were analyzed by analysis of variance (ANOVA) using PROC MIXED. For the amount of energy offered by owners, data for the transition week (week 0) were excluded because data on the amount of the previous food consumed was not recorded. For weight change, when an animal achieved its ideal body weight or body condition, it was dismissed from the study, and the last measured value was carried forward to the end of the study. An appropriate covariance structure was fit and the Kenward-Rogers adjustment was used to adjust the standard errors and test statistics for the presence of correlated errors in the model.

Time main effect and food x time interaction effect were partitioned into linear and quadratic trends using orthogonal polynomials. A random clinic effect was initially fit to the models, but the variance component associated with this effect was not signifi-

***Table 1**: Nutrient composition of experimental foods*

		HP/HF		HFIB	
Nutrient	Basis*	Wet	Dry	Wet	Dry
Protein	%	37.0	38.1	24.5	25.3
	g/100 kcal	8.4	8.9	8.2	8.6
Fat	%	23.8	20.9	8.43	8.49
	g/100 kcal	5.4	4.9	2.8	2.9
Soluble carbohydrate	%	31.5	32.8	40.4	38.0
	g/100 kcal	7.1	7.7	13.5	12.9
Ash	%	4.75	4.85	4.72	5.71
Crude fiber	%	2.97	3.32	22.0	22.5
	g/100 kcal	0.7	0.8	7.3	7.7
Metabolizable energy	kcal/100 g	442	426	299	294
	kcal/cup		417.0		219.9
	kcal/can	455.7		296.1	

**Percent was calculated on a dry-matter basis, and kcal was of metabolizable energy.*

Table 2: *Demographics and disposition at study start (week 0) of dogs completing the study according to protocol*

	HP/HF (n=32)	HFIB (n=30)	P-value
Sex, n (%)			
Male	18 (56%)	17 (57%)	0.92
Female	14 (44%)	13 (43%)	
Reproductive status			
Neutered/spayed	32 (100%)	30 (100%)	-
Body weight, kg			
Mean ± SD	28.5 ± 14.4	32.4 ± 15.1	0.31
Range	7.8 – 57.1	9.2 – 52.4	
BCS, score (1–5)			
Mean ± SD	4.44 ± 0.50	4.50 ± 0.51	0.62
Range	4 – 5	4 – 5	
Age, y			
Mean ± SD	6.1 ± 2.7	5.4 ± 3.1	0.38
Range	1 – 11	1 – 12	

SD=standard deviation. Sex and BCS scores were compared using a chi-square test. Body weight and age were compared using a t-test.

cant for any of the variables and therefore dropped from final models. Similarly, for the percent weight change, initial body weight at study start, the amount of reported energy fed by the pet owners, sex, clinic x food, and clinic x month did not account for a significant amount of variation and were dropped from the models. Age was a significant covariate for percent weight change and was kept in the model. Whether dogs ate all of the food was analyzed using a chi-square test and PROC GLIMMIX for a binomial distribution with a logit link function.

RESULTS

Nutritional Content of Study Foods

Nutritional content of the study foods is shown in Table 1. HP/HF contained higher amounts of protein and fat but lower amounts of fiber and soluble carbohydrate than HFIB, and the wet and dry formulations of each food had similar compositions. Also, HP/HF contained approximately twice as many calories as the HFIB foods on a volume basis (kcal/cup or kcal/can).

Demographics and Disposition of Study Animals

A total of 73 pet dogs were enrolled in the study. Of these, 37 were randomly assigned to receive HP/HF and 36 to receive HFIB. Eleven dogs were dismissed during the study, including five on HP/HF (four for noncompliance, and one for concurrent disease [tumor]) and six on HFIB (three for noncompliance, one for excluded medication, one for palatability of the food, and one for an adverse event [bilateral cruciate ligament rupture]). Thus, a total of 62 dogs completed the study according to protocol (32 fed HP/HF and 30 fed HFIB). In these 62 dogs, there were no significant differences in the mean age, weight, or BCS or in the distribution of sexes or reproductive status at study start (Table 2). Of the dogs fed HP/HF, 15 were fed dry food only and 17 a combination of dry and wet food. Of those fed HFIB, 11 were fed dry food and 19 a combination of dry and wet food.

Amount of Energy Fed and Consumed by Dogs

The investigators' feeding recommendations (Table 3) did not differ between the two foods (P=0.43), although the recommended amount of energy per day was reduced slightly over time (P<0.0001) because dogs initially were not reaching their target of 2% weight loss per week. In accordance with the investigators' feeding recommendations, there was a slight decrease over time in the amount of energy offered per day to dogs by owners (P=0.03). However, between the two foods, there was no difference in the average amounts of energy offered per day by the owners (P=0.26). Finally, there was some variability in the amount of recommended energy because the food was dispensed in fractions of cans or cups.

For both foods, dogs almost always ate all of the food. However, there was a slightly higher rate for dogs fed HP/HF than for dogs fed HFIB (frequency of eating all of the food = 94.7 ± 0.9% vs. 88.4 ± 1.3%, respectively; P<0.0001).

Owners reported supplementary energy intake a total of 305 and 318 times for dogs on HP/HF and HFIB, respectively. This included, for example, snacks offered by the owner or cases of the pet stealing food or rummaging through the garbage. On a monthly basis, there was no difference in the reported frequency of supplemental energy intake (65±5% for HP/HF vs. 66±5% for HFIB; P=0.91).

Weight Loss

Dogs fed both foods lost significant weight over time (P=0.006 for HP/HF and P<0.0001 for HFIB; Table 4). However, dogs fed HFIB lost significantly more weight than dogs fed HP/HF (P=0.009). Age was a significant factor and was adjusted for in the analysis. In contrast, the amount of energy offered by owners (excluding week 0), sex, initial body weight, and the frequency of consuming

***Table 3**:- Mean energy per day (kcal/day/kg ideal body weight$^{0.75}$) recommended by investigators and offered by owners*

	kcal/day/kg ideal body weight$^{0.75}$		P-value		
Weeks	HP/HF	HFIB	Food	Time	Food x Time
Recommended			0.43	<0.0001	0.37
1-4	69.3±0.6	69.4±0.7			
5-8	66.7±0.8	66.2±0.9			
9-12	66.3±0.6	65.6±0.8			
13-16	66.1±0.8	65.7±0.8			
17-20	65.6±0.7	64.4±0.8			
21-24	65.6±0.7	64.0±0.7			
Offered			0.26	0.03	0.37
1-4	71.4±1.6	66.1±1.6			
5-8	68.0±1.2	66.2±1.2			
9-12	66.9±1.0	66.0±1.0			
13-16	66.8±1.0	66.1±1.0			
17-20	66.1±1.3	66.1±1.4			
21-24	66.9±1.2	65.8±1.2			

P-values were calculated by ANOVA.

***Table 4**:- Percent weight change from initial body weight*

% Weight Change			P-values		
Week	HP/HF	HFIB	HP/HF over time	HFIB over time	HP/HF vs. HFIB
4	−2.5±0.6	−3.9±0.6	0.006	<0.0001	0.009
8	−4.4±0.8	−7.2±0.8			
12	−5.3±1.0	−9.3±1.0			
16	−5.0±1.4	−10.8±1.5			
20	−6.9±1.5	−12.1±1.6			
24	−6.8±1.7	−13.0±1.7			

P-values were determined by ANOVA and were age-adjusted.

all of the food offered were not significant factors in the difference between the foods. Results were similar when the dry and wet foods were considered separately (data not shown).

The week-0 data for energy offered by owners was excluded from the statistical analysis of weight loss because, during this week, dogs were gradually transitioned from their previous food to the study food, and data were not collected on the amount of the previous food offered. To determine whether this may have influenced the results, weight loss was also examined beginning at week 4, the next time point for which weight data were available. In this case, dogs fed both HP/HF and HFIB lost weight, and weight loss remained significantly greater for dogs fed HFIB, although age was no longer a significant factor (data not shown).

Adverse Events

There were a total of five adverse events reported (one for HP/HF and four for HFIB). Only two events were considered possibly related to the study foods: one case of moderate vomiting for a dog fed HP/HF and one case of mild lethargy/food-seeking behavior for a dog fed HFIB. Finally, according to owners, there were no significant differences in stool quality or the incidence of vomiting between dogs fed HP/HF and HFIB (data not shown).

DISCUSSION

The current randomized, blinded study showed that in a real-life home setting, dogs fed a high-fiber, low-fat food (HFIB) lose weight faster than dogs fed a more calorie-dense, high-protein/high fat food (HP/HF). This was despite owners' reports that they offered their dogs the same amounts of metabolizable energy.

According to owners, there was a small difference in the frequency of all food being consumed (94.7% for HP/HF vs. 88.4% for HFIB). Our statistical analysis indicated that this was not a significant factor in the difference in weight loss between the two foods. Also, differences in weight loss should not have been due to differences in availability of the energy in the two foods, as this was adjusted for in the determination of metabolizable energy contents. Finally, differences in weight loss should not have been due to differences in elimination because, according to owners, there were no differences in stool quality or incidence of vomiting.

Recently, German et al found in an open-label, non-blinded study that pet dogs in the home setting lose more weight and lose weight faster when fed a high-fiber/high-protein food than when fed a medium-fiber/high-protein food, despite apparently similar energy intake. They were unable to identify the reason for the difference in weight loss between the two foods, although they

considered supplementary energy intake as a possibility [13]. Like their study, ours was performed in the home setting and therefore lacked concise measures of the amount of supplementary energy intake. Like German et al., we suspect that supplemental energy intake was underreported. In particular, because the HP/HF food was relatively dense, the owners may have felt that the feeding guidelines were not sufficient and therefore may have decided to supplement with snacks or additional food, while the owners feeding HFIB are more likely to have been satisfied with the amount of food offered because of its larger volume. In addition, the fact that that dogs fed HP/HF more often ate all of the food suggests that they may have been hungrier and more aggressive in seeking alternative energy sources.

Fiber has been reported to improve satiety in dogs, although the results are somewhat controversial and may depend on the nutritional context. Butterwick et al reported that inclusion of different amounts and types of dietary fiber does not affect energy intake in dogs. [6,7] In contrast, Jewell and colleagues found that increasing fiber reduces voluntary energy intake (ie, increases satiety) and adiposity but not total grams of intake in beagle dogs. [4,14] Also, Weber et al reported lower voluntary food intake with a high-fiber/high-protein food than a moderate-fiber/high-protein or a high-fiber/moderate-protein food, [15] and Bosch et al recently reported that fermentable fiber appears to improve satiety in dogs. [16] Similar effects have been observed in humans.[17] In the current study, voluntary intake (owner-reported frequency of eating all of the food offered) was slightly higher with HP/HF than with HFIB (94.7% vs. 88.4%), consistent with an effect of fiber on satiety. However, our statistical analysis suggested that this alone cannot explain the differences in weight loss.

In this study, older dogs lost weight slower than younger dogs. This was adjusted for in our statistical analysis of weight loss. Slower weight reduction in older dogs has also been found by others. [18] This may be due to a reduction in lean body mass and lower activity levels in older dogs [19]. However, age was not a significant factor when we excluded the first 4 weeks from the analysis. Thus, the impact of age may have been greatest early in the study.

CONCLUSION

This study showed that in the home setting, obese dogs fed a high-fiber food lose weight faster than those fed a denser high-protein/high-fat food. Further studies in a more controlled setting are needed to determine to what extent owner (reduced supplemental energy offered) and pet behavior (increased satiety) contribute to the improved weight loss with the high-fiber food. These results should help in the recommendation of dietary approaches to weight loss in overweight dogs.

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