

# Efficacy of feeding a diet containing a high concentration of mixed fiber sources for management of acute large bowel diarrhea in dogs in shelters

Michael R. Lappin<sup>1</sup>  | Amy Zug<sup>1</sup> | Claire Hovenga<sup>1</sup> | Jason Gagne<sup>2</sup> | Emily Cross<sup>2</sup>

<sup>1</sup>Department of Clinical Sciences, Center for Companion Animal Studies, Colorado State University, Fort Collins, Colorado, USA

<sup>2</sup>Nestle Purina PetCare, St. Louis, Missouri, USA

## Correspondence

Michael R. Lappin, Department of Clinical Sciences, Center for Companion Animal Studies, 300 West Drake Road, Fort Collins, CO 80524, USA.  
Email: mlappin@colostate.edu

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## Abstract

**Background:** Use of diets with increased concentrations of dietary fiber is thought to be beneficial in the management of dogs with large bowel diarrhea.

**Objective:** To determine whether feeding a diet with high concentrations of soluble and insoluble fiber to dogs with acute colitis would be superior to feeding a diet with typical fiber levels.

**Animals:** A total of 52 dogs with acute signs of large bowel diarrhea housed in an animal shelter were entered into the study; 11 dogs per diet completed the protocol.

**Methods:** In this randomized, prospective study, dogs with a fecal score of 4, 5, 6, or 7 and signs of acute colitis were fed a high fiber diet (4.54% soluble; 15.16% insoluble fiber) or a standard diet (0.6% soluble; 5.33% insoluble fiber) and fecal scores compared over the course of the study with significance defined as  $P < .05$ .

**Results:** All dogs fed the high fiber diet (11/11; 100%) had a fecal score  $<5$  on the day of adoption or day 9, which was statistically different ( $P < .04$ ) than dogs fed the standard diet (6/11 dogs; 55%; 95% CI: 23-83). The proportions of stools with a fecal score  $>4$  were greater ( $P = .0001$ ) in the dogs fed the standard diet (29/48 samples; 60%; 95% CI: 45-74) compared to the high fiber diet (8/50 samples; 16%; 95% CI: 7-29).

**Conclusions and Clinical Importance:** The results support feeding the high fiber diet described herein to dogs with acute large bowel diarrhea.

## KEYWORDS

fiber, insoluble, microbiome, probiotic, soluble

## 1 | INTRODUCTION

Acute clinical signs of large bowel diarrhea are common in dogs housed in animal shelters and are often associated with parasites like *Trichuris vulpis* or stress that can lead to overgrowth of *Clostridium perfringens* and over production of toxins.<sup>1-4</sup> Dietary management of

dogs with chronic colitis has been described in some clinical studies, which have mentioned the potential therapeutic benefits of fiber.<sup>5-9</sup> However, data concerning dietary management of acute colitis in dogs housed in animal shelters are lacking.

Gastrointestinal benefits of feeding fiber are attributable, in part, to the degree of solubility of the respective fiber source. Dietary fiber

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sources that are insoluble adsorb water, resulting in increased fecal bulk; these are commonly used for clinical cases of soft or loose stool quality. In contrast, soluble fiber sources have an osmotic effect to draw water into the lumen resulting in a softer stool. While both sources increase fecal weight and water content, many soluble

fiber sources are fermentable by the microbial population and might be prebiotics or have prebiotic effects resulting in the production of short-chain fatty acids including butyrate, which is an energy source for colonocytes. Dogs fed the fermentable fiber beet pulp have increased villus height, intestinal surface area, and weight.<sup>10</sup>

Fecal Scoring Chart		
SCORE	SPECIMEN EXAMPLE	CHARACTERISTICS
1		<ul style="list-style-type: none"> <li>· Very hard and dry</li> <li>· Often expelled as individual pellets</li> <li>· Requires much effort to expel from body</li> <li>· Leaves no residue on ground when picked up</li> </ul>
2		<ul style="list-style-type: none"> <li>· Firm, but not hard, pliable</li> <li>· Segmented in appearance</li> <li>· Little or no residue on ground when picked up</li> </ul>
3		<ul style="list-style-type: none"> <li>· Log shaped, moist surface</li> <li>· Little or no visible segmentation</li> <li>· Leaves residue on ground, but holds form when picked up</li> </ul>
4		<ul style="list-style-type: none"> <li>· Very moist and soggy</li> <li>· Log shaped</li> <li>· Leaves residue on ground and loses form when picked up</li> </ul>
5		<ul style="list-style-type: none"> <li>· Very moist but has a distinct shape</li> <li>· Present in piles rather than logs</li> <li>· Leaves residue on ground and loses form when picked up</li> </ul>
6		<ul style="list-style-type: none"> <li>· Has texture, but no defined shape</li> <li>· Present as piles or spots</li> <li>· Leaves residue on ground when picked up</li> </ul>
7		<ul style="list-style-type: none"> <li>· Watery</li> <li>· No texture</li> <li>· Present in flat puddles</li> </ul>

**FIGURE 1** The Purina fecal scoring chart used to score the feces of dogs in this study

While the beneficial effect of supplementing different dietary fibers has been studied in a number of trials of healthy dogs, clinical trials using commercially available foods are generally lacking.<sup>8-14</sup>

The purpose of this randomized study was to determine whether feeding a commercially available veterinary diet containing a high concentration blend of soluble and insoluble fiber (Purina® Pro Plan® Veterinary Diets EN Gastroenteric Fiber Balance®, Nestle Purina PetCare, St. Louis, Missouri) would be associated with improved clinical outcomes when compared to a diet with more typical soluble and insoluble fiber concentrations (Purina® Pro Plan® Savor® Adult Shredded Blend Chicken & Rice Formula, Nestle Purina PetCare, St. Louis, Missouri) when fed to dogs housed in an animal shelter and exhibiting signs of acute colitis.

## 2 | MATERIALS AND METHODS

The affected dogs were housed in a single shelter and the experimental design was approved by the shelter board, by the Clinical Review Board at Colorado State University, and was overseen by the lead shelter veterinarian. The dogs were either stray or owner relinquished and were housed individually while in the shelter. A complete clinical history was not available for each dog. On admission to the shelter, all dogs were given a general health examination and vaccinated. Before being randomized and fed the study diets exclusively, all dogs had been fed a facility diet that consisted of a mixture of donated foods and so the pre-study diet might have varied among the dogs.

Daily fecal scores were determined by individuals masked to the diet groups by comparing to a standardized score sheet until day 9 or the dog was adopted (Figure 1; Purina Fecal Scoring Chart). Shelter staff members cleaning and feeding the dogs were instructed to alert the shelter veterinary team if a fecal score of  $\geq 4$  was noted in the run or cage of any dog in the shelter. A trained DVM student (CH, AZ) then evaluated the dog and the stool to confirm the fecal score, and to determine whether hematochezia, mucus, or straining to defecate was present, whether the dog had a normal appetite, and whether the dog was otherwise normal on physical examination. To be entered into the study, all dogs had to have a fecal score  $\geq 4$  and at least 1 of the signs of hematochezia, mucus, or straining to defecate. Dogs with small bowel diarrhea, hyporexia, or other physical examination or clinical abnormalities were excluded.

Qualifying dogs were randomized to be fed 1 of the 2 diets by the shelter staff (Table 1). The dogs were fed twice daily and were given a measured volume of food based on bodyweight as per the shelter standard feeding protocol. All dogs were administered fenbendazole at 50 mg/kg, PO, daily for 5 days and metronidazole at 10 to 15 mg/kg, PO, twice daily for 5 days using the shelter standard protocol starting the first day colitis was diagnosed. Feces collected from each dog before entering the trial was evaluated for parasitic eggs, cysts, and oocysts by microscopic examination after preparation using the Sheather's sugar centrifugation method as well as for *Giardia* spp. cysts and *Cryptosporidium* oocysts using a commercially available kit (Merifluor *Crypto/Giardia* kit, Meridian Diagnostic Corporation, Cincinnati, Ohio).

**TABLE 1** Nutrient profiles of the 2 diets fed in this study

Nutrient	High fiber diet		Standard diet	
	As Fed %	g/100 kcal	As Fed %	g/100 kcal
Protein	22.00	6.75	28.10	7.04
Fat	11.98	3.68	17.50	4.37
CHO	44.54	13.67	37.50	9.39
TDF	19.70	6.04	6.06	1.52
Soluble	4.54	1.39	0.60	0.15
Insoluble	15.16	4.65	5.33	1.33

Note: Energy = 3259 kcal/kg for the high fiber diet and 3997 kcal/kg for the standard diet.

Abbreviations: CHO, carbohydrate; TDF, total dietary fiber.

## 2.1 | Statistical analyses

A dog had to be in the study for at least 4 days to be included in the final data analysis. The proportions of dogs with a fecal score of  $< 5$  on the day of adoption or the last study day (day 9) and the proportions of stools in each group with a fecal score  $> 4$  after beginning the trial were compared by Fisher's exact test with significance defined as  $P < .05$ .

## 3 | RESULTS

A total of 52 dogs were entered into this study, with 22 dogs (11 per diet) completing the protocol. All dogs not completing the study left the shelter because of successful placement into a new home. In the high fiber diet group, there were 6 male and 5 female dogs that were all estimated to be greater than 1 year of age with bodyweights that ranged from 3.1 to 34.1 kg (median = 20.45 kg). In the standard diet group, there were 8 male and 3 female dogs that were all estimated to be greater than 1 year of age with bodyweights that ranged from 2.91 to 44.09 kg (median = 24.55 kg). Both diets were consumed by the dogs and no vomiting was noted during the trial.

Over the course of the study, mucus, hematochezia, or straining resolved in all 22 dogs. All of the dogs fed the high fiber diet (11/11; 100%) had a fecal score  $< 5$  on the last day feces was available for scoring, which was different ( $P < .04$ ) than for dogs fed the standard diet (6/11 dogs; 55%; 95% CI: 25-84). After starting the diet trial, the proportions of stools with a fecal score  $> 4$  were significantly greater ( $P = .0001$ ) in the dogs fed the standard diet (29/48 samples; 60%; 95% CI: 45-74) compared to the high fiber diet (8/50 samples; 16%; 95% CI: 7-29).

*Giardia* cysts alone were detected in 1 dog fed the high fiber diet and 2 dogs in the standard diet. *Giardia* cysts and *Cryptosporidium* oocysts were detected concurrently in 2 dogs of each diet group. None of the parasitized dogs fed the high fiber diet had clinical manifestations of diarrhea by the last day of fecal scoring (days 6, 8, and 9). Diarrhea was still present on the last day of fecal scoring (days 8 and 9) for 2 parasitized dogs fed the standard diet. Follow-up testing on feces was not available.

## 4 | DISCUSSION

The majority of dogs developing signs of colitis in this study were medium to large breeds with median weights of 20.45 and 24.55 kg in the high fiber diet and standard fiber diet groups, respectively. A detailed history for all dogs was not known and is a limitation in this study. It is possible that some of the 5 dogs in the standard fiber diet group that had persistent abnormal stools at the end of the 9 day study could have had a chronic enteropathy, potentially leading to failure to respond in this short term trial. However, all the dogs were believed to have entered the shelter with normal fecal scores and the study was randomized. In addition, all dogs ultimately had resolution of diarrhea and were rehomed making it unlikely that there were underlying enteropathies. Thus, we believe the results of this study reflect a dietary response in the dogs that consumed the high fiber diet when compared to the dogs that consumed the standard fiber diet.

As shown in Table 1, the nutrient profiles of the 2 diets differ and so it is difficult to determine which factor could potentially explain the apparent treatment response in this study. When diets are formulated, altering 1 nutrient value affects the concentration of other nutrients. The standard fiber diet had slightly higher protein and fat concentrations while the total carbohydrate and fiber concentrations were higher in the high fiber diet. The greatest differences between the 2 diets were the soluble and insoluble fiber concentrations, which were 7.6 and 2.8 times higher in the high fiber diet when expressed as % fed, respectively. We believe these differences account for the statistically significant differences in clinical responses noted between diets. Overall, we conclude the results support the feeding of the high fiber diet to dogs with acute large bowel diarrhea.

*Trichuris vulpis* is a known cause of colitis in dogs but eggs were not detected in any dog of this study.<sup>2</sup> Negative results for *T. vulpis* are not surprising because of the small sample size and the fact that this parasite frequently is shed intermittently. Future studies should consider use of nematode antigen tests to increase sensitivity for *Toxocara* spp., *Ancylostoma caninum*, and *T. vulpis*.<sup>15</sup> In addition, fenbendazole was administered to all dogs in an attempt to exclude any confounding effects induced by nematode parasitism. This drug does not affect the fecal microbiome.<sup>16</sup>

*Giardia* spp. with or without *Cryptosporidium* spp. infections were documented in some dogs in both diet groups. Both of these agents parasitize the small intestines and the role each play in the development of large bowel diarrhea is unclear. All dogs were treated with fenbendazole, which has an effect on *Giardia* spp. but not *Cryptosporidium*.<sup>16</sup> As noted in the results, none of the parasitized dogs fed the high fiber diet had clinical manifestations of diarrhea by the last day of fecal scoring, whereas diarrhea was still present on the last day of fecal scoring for 2 parasitized dogs fed the standard diet. High fiber diets have been promoted as effective for giardiasis but whether a high fiber diet has an effect on either parasite should be explored in future studies.<sup>17,18</sup>

At the time of this study, the participating shelter administered metronidazole to all dogs with diarrhea and so that protocol was followed. While fenbendazole does not affect the fecal microbiome, metronidazole does.<sup>19</sup> Dogs with small bowel diarrhea treated with metronidazole and

the commercially available probiotic *Enterococcus faecium* SF68 (Purina® Pro Plan® Veterinary Supplements FortiFlora®, St. Louis, Missouri) have improved clinical scores compared to dogs treated with metronidazole alone in a randomized trial.<sup>20</sup> In addition, there is a beneficial effect from the use of a probiotic on dogs with hemorrhagic gastroenteritis suspected to be from *Clostridium perfringens*.<sup>21</sup>

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## CONFLICT OF INTEREST DECLARATION

While 2 of the authors (Drs J. Gagne and E. Cross) are employees of the sponsor, Nestle Purina PetCare, they were not involved in the data collection, entry, or analysis. They provided nutritional consultation and edits in the preparation of the final document. None of the authors were paid for the work performed in the completion of this study.

## OFF-LABEL ANTIMICROBIAL DECLARATION

Authors declare no off-label use of antimicrobials.

## INSTITUTIONAL ANIMAL CARE AND USE COMMITTEE (IACUC) OR OTHER APPROVAL DECLARATION

We received a waiver from the Colorado State University committee because this study was a clinical trial with shelter owned animals. The study was approved by the shelter board, by the Clinical Review Board at Colorado State University, and Nestle Purina PetCare.

## HUMAN ETHICS APPROVAL DECLARATION

Authors declare human ethics approval was not needed for this study.

## ORCID

Michael R. Lappin  <https://orcid.org/0000-0003-1605-9667>

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