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Effect of a Commercially Available Electrolyte Solution on Acute, Non-Specific Diarrhea in Dogs

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Abstract

Purpose: To determine if a commercially available electrolyte solution is safe and lessens the duration and severity of diarrhea in shelter dogs in stressful situations. **Methods:** In Experiment 1, six healthy beagles were administered the protocol-approved dose of the electrolyte solution to evaluate clinical, biochemical, or fecal microbiome changes. In Experiment 2, 22 dogs with small or large bowel diarrhea were randomized into one of three groups: the electrolyte solution and a prescription veterinary diet, a placebo and a prescription veterinary diet, or the electrolyte solution and a standard diet. A fecal score was assigned by trained, masked observers through Day 5 using the Purina 7-point fecal scoring system. All dogs were screened for enteric parasites by fecal flotation and the use of a fluorescence antibody assay for *Giardia* spp. cysts and *Cryptosporidium* spp. oocysts and all dogs that were parasitized were administered fenbendazole for five days. **Results:** In Experiment 1, all dogs tolerated the electrolyte solution with no vomiting or diarrhea noted and there was no evidence of negative effects on the gastrointestinal microbiome. In Experiment 2, 16 of the 22 dogs enrolled in the study had a normal stool the day after the first dose of the electrolyte solution, prescription diet, or placebo. All six dogs with the first day of normal stool detected after Day 1 were parasitized. When the days to normalcy were compared, the parasitized dogs had a significantly slower resolution ($P = 0.018$) than dogs with no parasites regardless of the other treatment group. **Conclusions and Relevance:** The results of the study suggest that this electrolyte solution is safe for use in dogs and that adding the electrolyte solution to a standard diet is equivalent to using a therapeutic diet alone or the electrolyte solution combined with a therapeutic diet.

Keywords

Diarrhea, Electrolyte, Giardia, Coccidia

1. Introduction

Dogs housed in animal shelters frequently developed non-specific diarrhea that is commonly associated with bacteria, viruses, or parasites [1]. Nematodes like *Ancylostoma caninum*, *Toxocara canis*, and *Trichuris vulpis* and the protozoans *Giardia lamblia*, *Cryptosporidium canis*, and *Cystoisospora* spp. are commonly found to be involved in non-specific diarrhea cases [2]. Dehydration and electrolyte disturbances are common in cases of diarrhea and the management of these problems is a large part of many budgets in shelters. In addition, diarrhea causes discomfort and slows adoption which also increases expenses to shelters. Due to negative effects on the fecal microbiome, current recommendations suggest not using oral antibiotics routinely in dogs with non-specific diarrhea. Thus, other treatment pathways for the management of acute non-specific diarrhea are needed [3].

The electrolyte solution (ES; SxDog, EcoPlanet), is classified as a nutritional supplement that has been shown to be effective in the management of dehydration and diarrhea in calves (https://ecoplanetonehealth.com/). The inventors have shown safety in a limited number of dogs in an unpublished open trial when used to treat non-specific diarrhea in several local veterinary clinics.

The primary objective of Experiment 1 was to assess whether the product is safe to administer to healthy beagles and to determine the effects on the fecal microbiome. The hypothesis for Experiment 1 was that ES would have no noticeable side effects or toxicity and would have no negative effects on the fecal microbiome.

The primary objective of Experiment 2 was to dose dogs with diarrhea in a shelter the ES with a prescription diet, the ES with a standard diet, or a prescription diet alone. The hypothesis for Experiment 2 was that diarrhea response rates would be similar amongst the groups of dogs.

2. Methods

2.1. Experiment 1—Healthy Dogs

A total of six healthy laboratory raised mixed sex, 2- to 5-year-old beagles were used in this IACUC-approved study (170-052). The dogs were on a standard facility diet for over 12 weeks and were housed individually.

On Day 0, physical examinations were performed, and blood was collected for complete blood cell counts (CBC) and serum biochemical panels. In addition, feces were collected for fecal flotation, *Giardia* and *Cryptosporidium* immunofluorescent antibody assay (MeriFluor, Meridian Diagnostics), and for fecal microbiome assessment (Gastrointestinal Laboratory, Texas A & M University,

School of Veterinary Medicine & Biomedical Sciences, College Station, TX). Dogs were then treated with the ES at 1.5 ml/kg on Day 0 and Day 1. The dogs were evaluated daily on Days 0-14 by abdominal palpation and for attitude, appetite, vomiting, diarrhea, inappetence, and for a fecal character using a standardized scoring system (Table 1). Tympanic membrane temperatures were recorded daily. CBC and serum biochemical panels were repeated on Days 7 and 14 to evaluate for toxicity.

2.2. Experiment 2—Clinical Trial

Dogs housed in a shelter in north-central Colorado with acute diarrhea (score of >4) were approved for entry by the shelter veterinarian. Dogs with inappetence, fever, BW loss > 2%, dehydration > 3% - 5%, vomiting, abdominal pain, abdominal masses, or a positive parvovirus antigen test on feces were excluded.

Feces from all dogs were tested on site at the shelter for *Giardia* spp. using a commercially available antigen assay (SNAP *Giardia*; IDEXX Laboratories, Portland ME). Feces were also evaluated by fecal flotation and *Giardia*/*Cryptosporidium* IFA. After the SNAP *Giardia* assay was performed, 2 grams of feces

Table 1. Clinical scoring parameters were measured daily by masked, trained observers in Experiment 1 and the fecal scoring rubric used in both Experiments 1 and 2.

Score		Description
Appetite Score	0	All food consumed
	1	1/2 of food consumed
	2	1/4 of food consumed
	3	None of the food consumed
Attitude Score	0	Bright, active, and alert
	1	Mild lethargy or depression
	2	Moderate lethargy or depression
	3	Severe lethargy or depression
Hydration Score	0	Normal
	1	5% - 8% dehydrated
	2	8% - 10% dehydrated
	3	10% - 12% dehydrated
Fecal Score	0	No stool
	1	Very hard and dry
	2	Firm but not hard
	3	Normal, little or no segmentation, moist
	4	Very moist, log shaped
	5	Very moist, piles
	6	Texture but no defined shape
	7	Watery puddle

were transferred to the Center for Companion Animal Studies for microscopic examination for parasite eggs, cysts, and oocysts after sugar centrifugation as well as a commercially available fluorescent antibody assay for *Giardia* cysts and *Cryptosporidium* oocysts (Meridian Diagnostics). Dogs positive for *Giardia* spp. had the assemblage determined as previously described [4]. The fecal flotation and fluorescent antibody assay were performed again on Day 5 or the day the dog was adopted.

A random number generator was used to assign the treatment groups which included the ES with the facility diet, the ES with a veterinary prescription diet (Hill's Pet Nutrition Prescription Diet i/d), or the veterinary prescription diet alone. Dogs with *Giardia* or nematodes were administered fenbendazole at 50 mg/kg, PO daily for five days. The feces were scored daily (**Table 1**). The body weight of each dog was determined on Day 0 and Day 5 or the day the dog was adopted. A medicine consultation was available for these cases as requested by the shelter veterinarian.

3. Statistical Evaluation

To be included in the final data analysis, each dog was enrolled in the study for at least 4 days. The proportion of dogs with parasites by groups were compared by Fisher's exact test. The mean and standard deviations for the days to the first normal stool were calculated for each group and compared by student's t-test. Significance was defined as $P < 0.05$ in all analyses.

4. Results

4.1. Experiment 1—Healthy Dogs

All six dogs were administered the protocol approved dose of ES on two consecutive days (1.5 ml/kg, PO). There was no salivation or vomiting noted in any of the dogs during or after administration. There were no significant findings in any of the four monitoring rubrics (**Table 1**). The body weight changes for each dog over the course of the study were within normal limits. A total of five dogs had complete data sets and no significant changes were noted on the CBC. One dog had a clot in the pre-treatment complete blood cell count sample, but the Day 7 and Day 14 results were all within normal limits. Complete data sets were available for all dogs and there were no changes of significance over time that could relate to toxicity. In the microbiome assessment of the healthy dogs, there was no evidence of a dysbiosis.

4.2. Experiment 2—Clinical Trial

A total of 43 dogs were screened for inclusion in the study. Of these dogs, a total of 22 dogs (10 dogs fed ES plus i/d; seven dogs fed placebo and i/d alone; five dogs fed ES and a standard diet) remained in the study long enough to generate data for analysis. Parasites detected included *Giardia* spp., *Cystoisospora* spp. *Cryptosporidium* spp., *Ancylostoma caninum*, and *Toxocara canis* (**Table 2**).

The mean and standard deviation of the day to first normal stool after the first dose of ES or placebo was calculated for the three groups of dogs and no significant differences were recognized (Figure 1). Overall, 16 of the 22 dogs had a normal stool the day after the first dose of ES or placebo. Of the six dogs with a slow response to normalcy (first normal stool detected after Day 1), two dogs were fed ES plus i/d, one dog was fed placebo and i/d alone, and three dogs were fed ES and a standard diet.

All six dogs with the first day of normal stool detected after Day 1 were parasitized and when the mean and SD of the days to normalcy were compared between parasitized dogs (1.7 ± 0.99) and dogs with no parasites (1 ± 0), the parasitized dogs had a significantly slower response (P = 0.018). All six dogs with a coccidian parasite (*Cryptosporidium* spp. or *Cystoisospora* spp.) were in an ES group and of these dogs, four had a response to normalcy > 1 day. Of the three

Table 2. Distribution of parasites in the dogs of the study. There are no significant differences in the prevalence rates amongst the three groups (P > 0.05).

Group	Parasite Species				Parasitism Prevalence	
	Giardia spp.	*Cryptosporidium* spp.	*Cystoisospora* spp.	Other	Any Parasite	% Any Parasite
Dogs on ES[a] & i/d[b]	5	1	3	1 *Ancylostoma*	8	80%
Dogs on placebo & i/d[b]	2	0	0	1 *Trichuris vulpis*	3	42.90%
Dogs on ES[a] & normal diet	1	2	0	0	3	60%

a. ES = Electrolyte Solution. b. i/d = Hill's Pet Nutrition Prescription Diet i/d.

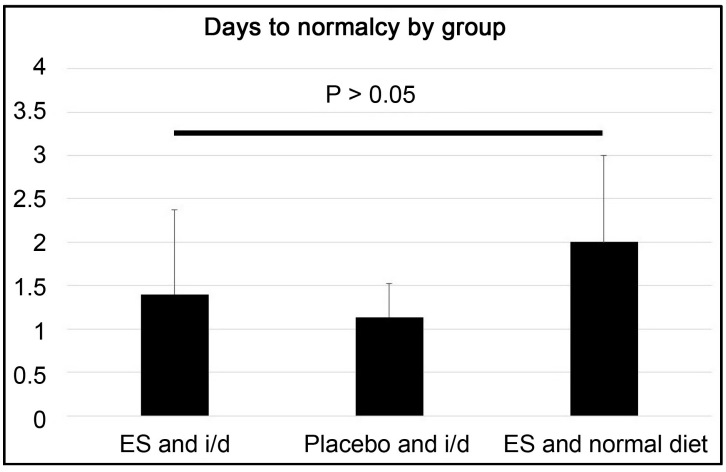

Figure 1. The number of days to normalcy for each of the three groups: ES and i/d, placebo and i/d, and ES and normal diet.

dogs with a response to normalcy on Day 3 or Day 4, all were infected with *Cryptosporidium* spp. or *Cystoisospora* spp. There were six dogs infected with *Giardia* spp. alone and each of these dogs was normal by Day 1 (four dogs) or Day 2 (two dogs). All the *Giardia* positive dogs with adequate DNA for sequencing were infected by the non-zoonotic assemblage C genotype.

5. Discussion

In Experiment 1, the ES was shown to be safe in laboratory reared dogs. This conclusion was based on clinical findings (no vomiting or diarrhea) and no abnormal biochemical findings. Additionally, there was no induction of dysbiosis detected from the microbiome analysis.

In Experiment 2 in shelter dogs, it was shown that ES could be used with whatever diet they were currently being fed. The results of this study suggest that ES added to a standard diet is equivalent to using a therapeutic diet alone or the ES combined with a therapeutic diet. However, the major limitation is the sample size. Not having to use a therapeutic prescription diet potentially saves money and the time it might take to get a prescription diet ordered for owners.

In this study, it was shown that parasitism, particularly in the coccidian group, may lead to a slower response and resolution of diarrhea than a viral or bacterial agent. Therefore, the results support doing a fecal examination in the workup of shelter dogs with acute diarrhea. In a future study, it would be interesting to see if clinical responses were improved if the electrolyte solution was combined with specific drugs for the parasite that was diagnosed. Finally, the *Giardia* spp. identified from the fecal samples were not zoonotic, which is similar to many studies performed in the USA in general and the USA in specific [5] [6].

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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