Accurate Diagnosis of *Giardia* spp and Proper Fecal Examination Procedures*

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**INTRODUCTION**

A fecal examination is considered a routine procedure in many veterinary practices, but in our experience, often little thought is given to performing the procedure correctly. Although fecal flotations should be performed by veterinarians or trained veterinary technicians, the assignment is commonly given to the newest staff member, with very little instruction or emphasis on the importance of the task provided. For the past 10 years, informal surveys of second-year veterinary students at Kansas State University indicate that more than 90% of the students had conducted “fecal examinations” in practices where they had worked or volunteered, yet most of these students had no formal training in the proper performance of a fecal flotation or identification of parasite eggs, oocysts, or cysts.

Accurate evaluation of fecal samples is important and must be taken seriously by all members of the clinical practice. Not only is pet health at stake, but several of the parasites that may be recovered and identified are potentially zoonotic, such as *Toxocara canis, Toxocara cati, Ancylostoma caninum, Giardia* spp, *Cryptosporidium parvum*, and *Toxoplasma gondii*. A recently published study demonstrated that a 5-minute swing-head centrifugation technique could recover more parasite eggs and
and emails we receive, we realize that many veterinary practices find it difficult to diagnose this disease using fecal examinations. There are several reasons why identifying giardiasis is difficult in private practice. Many pseudoparasites, such as yeasts (Figure 1), plant remnants, and debris, have been mistaken for these tiny organisms. Identification of *Giardia* cysts is further compromised because microscopes used in private practice are often not equipped with micrometers that can allow measurement of cysts as small as 8 to 12 × 7 to 10 µm. Cysts are shed intermittently, and repeated fecal analyses may be needed before cysts are recovered in a sample.\(^2\,^3\) Cysts are delicate and deteriorate rapidly in fecal flotation solutions; if a fecal examination is conducted using a solution other than zinc sulfate (ZnSO\(_4\)), the cysts may be distorted (Figures 2 and 3). In many clinics, the only technique used is the direct smear; however, trophozoites are fragile and are often found only in very fresh, diarrheic feces. Finally, because of the difficulty in detecting *Giardia* spp, veterinarians have told us that they often rely on a patient’s response to metronidazole treatment as a presumptive diagnosis.

Several studies have demonstrated that recovery of *Giardia* cysts can best be accom-
plished using a 1.18–specific gravity (SG) ZnSO$_4$ centrifugation technique.$^{2-5}$ This has been the diagnostic test of choice for many veterinary practices and veterinary diagnostic laboratories, including that of Kansas State University. While the ZnSO$_4$ centrifugation technique recovers and maintains the integrity of Giardia cysts more consistently than other flotation techniques, it still does not alleviate the problem of proper cyst identification. Several fecal antigen tests have been developed that appear to have high sensitivity in detecting Giardia antigen in human feces; however, they do not have the same level of sensitivity in detecting giardiasis in dogs and cats when compared with centrifugation using ZnSO$_4$. $^{3,4,6}$

This article describes several investigations that were designed to compare the fecal antigen SNAP Giardia Test Kit (Idexx Laboratories) and a ZnSO$_4$ centrifugation fecal flotation technique. Additional data on centrifugation versus a passive fecal flotation technique for the recovery of parasite eggs and oocysts are also presented so that more complete recommendations can be made concerning routine parasite diagnostic procedures for private veterinary hospitals.

### MATERIALS AND METHODS

Two groups of purpose-bred beagles (14 in 2004; 12 in 2005) housed at the Animal Resource Facility at Kansas State University for other research projects were found to be naturally infected with Giardia spp and shedding cysts on a routine basis. In 2004, the 14 dogs had been allocated for the other research project to eight runs, with two dogs in each of six runs and one dog each in two other runs. In 2005, the 12 dogs had been allocated to seven runs, with two dogs in each of five runs and one dog each in two other runs. In 2004, the 14 dogs had been allocated for the other research project to eight runs, with two dogs in each of six runs and one dog each in two other runs. In 2005, the 12 dogs had been allocated to seven runs, with two dogs in each of five runs and one dog each in two other runs. Once a week for 4 to 5 weeks, feces was collected from the runs and examined for the presence of Giardia cysts. An attempt was made to collect feces from each dog in pens that housed two dogs. The fecal samples from a pen were mixed thoroughly and split into two subsamples. One

### Standard Swing-Head Centrifugation Fecal Examination Technique

1. Weigh out 2–5 g of feces.
2. Mix feces with approximately 10 ml of flotation solution.
3. Pour mixture through a tea strainer into a beaker or fecal cup.
4. Pour strained solution into a 15-ml centrifuge tube.
5. Fill tube with flotation solution so that a slight positive meniscus forms.$^a$
6. Place a coverslip on the tube, and put the tube in the centrifuge.
7. Make sure the centrifuge is balanced.
8. Centrifuge at 1,200 rpm (280 $\times$g) for 5 minutes.
9. Remove the tube and let stand 10 minutes.
10. Remove the coverslip, and place it on a glass slide. Systematically examine the entire area under the coverslip at 100$\times$ magnification (i.e., 10$\times$ objective). You may wish to use the 40$\times$ objective lens to confirm your diagnosis and make measurements; however, with practice, most parasites can be identified using the 10$\times$ objective (100$\times$ magnification).

$^a$Do not overfill the tube. Doing so will cause some of the floating eggs to be forced down the side of the tube when the coverslip is placed.

subsample was evaluated with a swing-head centrifugation technique (see box on page 6) using 1.18-SG ZnSO$_4$, with one drop of Lugol’s iodine placed on the slide before placement of the coverslip. The second subsample was evaluated using the SNAP Giardia Test Kit according to label directions. Samples were scored as either positive or negative. Each fecal sample was evaluated by one of the authors (V.S.), who has more than 14 years of experience conducting and examining fecal samples at Kansas State University.

A third evaluation of the SNAP Giardia Test Kit was conducted by second-year veterinary students during the fall of 2005. Fecal samples from 116 puppies were provided by a local broker. These students had just listened to a lecture on giardiasis, been given a short visual presentation on identification of Giardia cysts, and had previously conducted direct smears and fecal examinations using the swing-head centrifugation technique before participating in this exercise. Students were also given written directions on conducting SNAP Giardia tests.

For the direct smear, a small sample of feces was placed on a glass slide and mixed with a drop or two of saline. The material was spread thinly, a drop of Lugol’s iodine was added, and the slide was covered with a glass coverslip. Each fecal sample was analyzed using a direct smear technique, centrifugation, and the SNAP Giardia Test Kit. Samples and techniques were recorded as either positive or negative. Each of the 107 veterinary students conducted at least one fecal examination, and nine students evaluated two samples.

Data for the final evaluation of diagnostic techniques came from a “wet lab” conducted at the 2005 Central Veterinary Conference. A group of veterinarians and veterinary technicians attended a wet lab on conducting proper fecal examinations. Participants were provided with a fecal sample from naturally parasitized dogs. The sample was a pooled sample from several dogs and contained eggs of A. caninum, Eucoleus boehmi, Taenia spp, T. canis, and Trichuris vulpis; oocysts of Cystoisospora spp; and Giardia spp cysts. In addition, the sample tested positive on the SNAP Giardia fecal antigen test kit.

Participants were given a short lecture before the wet lab on how to conduct the various techniques, provided written instructions, and shown color images of all parasite eggs, oocysts, and cysts that were in the fecal sample. Visual instruction included images of Giardia cysts recovered in ZnSO$_4$ and sugar solutions (Figures 2 and 3). Each participant collected two “quarter-sized” samples from the feces and conducted a 15-minute Ovassay (Synbiotics), a swing-head centrifuge technique (5-minute spin at 280 $\times$g followed by a 10-minute wait before analysis; see box on page 6), and a SNAP Giardia test. The participants were divided into two groups:

- Group 1 used 1.18-SG ZnSO$_4$ for the flotation solution and added one drop of Lugol’s iodine to the slide before placing the coverslip.

### Modified Sheather’s Solution (SG 1.27)$^a$

454 g granulated sugar  
355 ml tap water  
6 ml formaldehyde

Dissolve sugar and water in the top of a double boiler or with gentle heat. If solution is not clear, filter it through coarse filter paper.

$^a$Check specific gravity (SG) with a hydrometer that has a range compatible with the solution being tested. Hydrometers with ranges of 1.000–1.400 are available.
Group 2 used 1.27-SG Sheather's sugar solution (see box on page 7).

Participants were asked to record the number of eggs, oocysts, or cysts recovered as 0, 1 to 10, 11 to 50, or more than 50 per slide. Completed results were returned by 14 participants in Group 1 and 13 in Group 2.

### RESULTS

As is typical of *Giardia* infections, cyst shedding was not consistent during the evaluation period of the naturally infected beagles (Tables 1 and 2). Fecal samples from beagles evaluated in 2004 were found to be positive using the ZnSO$_4$ centrifugation method 87.5%, 75%, 37.5%, and 50% of the time during weeks 1, 2, 3, and 4, respectively. During 2005, fecal samples from the beagles were found to be positive using the ZnSO$_4$ centrifugation method 57.14% of the time in week 1 and 85.57% during weeks 2 and 3, and all were positive in week 5 (Table 2). The SNAP *Giardia* fecal antigen test produced a positive reaction 85.57% of the time in fecal samples collected during weeks 1 to 3, and all samples were antigen positive in weeks 4 and 5 (Table 2).

Interestingly, there were times when one or both tests produced false-negative results (Tables 1 and 2). In 2004, when results from both tests were combined, the accuracy of diagnosis was increased during three of the four weeks. Combining test results led to a positive diagnosis in 100.0%, 75.0%, 50.0%, and 75.0% of the fecal samples during weeks 1, 2, 3, and 4, respectively. During 2005, fecal samples from the beagles were found to be positive using the ZnSO$_4$ centrifugation method 57.14% of the time in week 1 and 85.57% during weeks 2 and 3, and all were positive in week 5 (Table 2). The SNAP *Giardia* fecal antigen test produced a positive reaction 85.57% of the time in fecal samples collected during weeks 1 to 3, and all samples were antigen positive in weeks 4 and 5 (Table 2).

### TABLE 1. Evaluation of Repeated 1.18-SG ZnSO$_4$ Centrifugation Fecal Flotations and SNAP *Giardia* Tests to Identify *Giardia*-Positive Beagles: Trial 1, 2004

<table>
<thead>
<tr>
<th>Pen No.</th>
<th>No. of Dogs</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
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<td></td>
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<td>SNAP</td>
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No. of dogs or pens testing positive

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<th>7</th>
<th>5</th>
<th>6</th>
<th>4</th>
<th>3</th>
<th>4</th>
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<th>5</th>
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</thead>
</table>

Total no. of dogs or pens testing positive

<table>
<thead>
<tr>
<th></th>
<th>8</th>
<th>6</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
</table>
of the fecal samples during weeks 1, 2, 3, and 4, respectively. In the 2005 trial, however, only during week 3 did combining test results increase diagnostic accuracy (Table 3).

In the evaluations conducted by the second-year veterinary students, almost half (56 of 116) of the puppy fecal samples were recorded as positive for *Giardia* (Table 3). The direct smear technique detected the fewest number of positive samples, with students recording only four positive samples. These direct smear technique data may be artificially low since the fecal samples were collected several hours before being tested and trophozoites may have been dead at the time of examination. Students recorded that the SNAP *Giardia* fecal antigen test identified 11 samples as *Giardia* positive even though they did not identify any cysts with the ZnSO$_4$ centrifugation technique (Table 3). There was only one fecal sample that was positive in the ZnSO$_4$ centrifugation technique and negative on the SNAP *Giardia* fecal antigen test.

Table 2. Evaluation of Repeated 1.18-SG ZnSO$_4$ Centrifugation Fecal Flotations and SNAP *Giardia* Tests to Identify *Giardia*-Positive Beagles: Trial 2, 2005

<table>
<thead>
<tr>
<th>Pen No.</th>
<th>No. of Dogs</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
</tr>
</thead>
<tbody>
<tr>
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<td>–</td>
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<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
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<td>2</td>
<td>+</td>
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<td>–</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>–</td>
<td>+</td>
<td>+</td>
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<td>+</td>
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<td>1</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

No. of dogs or pens testing positive
4 6 6 6 7 7 7

Total no. of dogs or pens testing positive
6 6 7 7 7 7

Twenty-seven participants returned completed forms from the Central Veterinary Conference wet lab. The centrifugation versus passive flotation technique data from the wet lab demonstrated that centrifugation with either 1.18-SG ZnSO$_4$ or 1.27-SG Sheather’s sugar solution routinely recovered more eggs and oocysts than the passive Ovassay technique (Table 4). Not only did the centrifugation technique recover more eggs and oocysts, but the participants also recorded many more samples as positive with the centrifugation technique. Only once did the Ovassay technique recover all parasites in all samples; in contrast, only once did the centrifugation technique fail to recover all parasites in all samples (Table 4). Only two of 14 participants in Group 1 (1.18-SG ZnSO$_4$ solution) recovered *Taenia* eggs using the centrifugation procedure, whereas all 13
participants in Group 2 (1.27-SG Sheather’s sugar solution) recovered *Taenia* eggs using the centrifugation technique (Table 4).

Even though the participants in the wet lab were told the samples were positive for *Giardia* cysts, recovery and identification of *Giardia* cysts was problematic for the participants regardless of the technique used. Only six of 27 participants were able to recover and identify *Giardia* cysts from a known positive sample: One participant using the centrifugation technique with ZnSO$_4$, one using Ovassay with ZnSO$_4$, one using Ovassay with Sheather’s sugar solution, and three using the centrifugation technique with Sheather’s sugar solution. All 27 participants had a positive SNAP *Giardia* fecal antigen test on the sample provided.

**DISCUSSION**

A 1.18-SG ZnSO$_4$ flotation with centrifugation should be adequate for the diagnosis of *Giardia* spp by trained personnel, but because many clinics do not use centrifugation techniques and cyst shedding is intermittent, it is often necessary to examine several sequential daily samples to ensure accuracy of diagnosis. The intermittent nature of cyst shedding was particularly evident in the evaluation of samples from beagles during 2004. In the trials evaluating repeated fecal examinations from research beagles, a single ZnSO$_4$ fecal flotation with centrifugation was positive 37.5% to 87.5% of the time in the 2004 investigation and 57.14% to 100% of the time in the 2005 investigation. The sensitivity of the SNAP *Giardia* fecal antigen test was comparable, with positive results obtained 50% to 62.5% of the time in the 2004 investigation and 85.57% to 100% in the 2005 investigation. This further demonstrates that a single negative ZnSO$_4$-flotation with centrifugation.

### TABLE 3. Evaluation by Second-Year Veterinary Students of 1.18-SG ZnSO$_4$ Centrifugation Fecal Flotations and SNAP *Giardia* Tests to Identify *Giardia* spp in Puppies

<table>
<thead>
<tr>
<th>Category</th>
<th>SNAP+</th>
<th>ZnSO$_4$+</th>
<th>ZnSO$_4$−/SNAP−</th>
<th>ZnSO$_4$+/SNAP−</th>
<th>SNAP+</th>
<th>SNAP−</th>
<th>Combined Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of samples in each category (total no. of samples tested = 116)</td>
<td>55</td>
<td>45</td>
<td>11</td>
<td>1</td>
<td>44</td>
<td>60</td>
<td>56</td>
</tr>
<tr>
<td>Percentage of samples in each category</td>
<td>47.41%</td>
<td>38.79%</td>
<td>9.48%</td>
<td>0.86%</td>
<td>37.93%</td>
<td>51.72%</td>
<td>48.28%</td>
</tr>
<tr>
<td>Percentage of 56 samples recorded as <em>Giardia</em> positive identified as positive by each specific procedure</td>
<td>98.21%</td>
<td>80.36%</td>
<td>19.64%</td>
<td>1.79%</td>
<td>78.57%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
cal flotation with centrifugation or a negative in-clinic Giardia fecal antigen test does not necessarily rule out Giardia infection. Interestingly, if three consecutive weekly ZnSO₄ fecal flotations with centrifugation were performed on the beagles in either trial, a positive diagnosis would have occurred in 100% of the beagles. This is in agreement with a previous investigation that demonstrated that it may take three consecutive ZnSO₄ fecal flotations to achieve 94% accuracy in positive Giardia diagnosis.² The problem is that in a private practice, conducting three fecal examinations on samples collected on consecutive days is often impractical.

Although the ZnSO₄ centrifugation procedure conducted by a well-trained technician has been considered the gold standard for the diagnosis of Giardia spp in dogs²⁻⁵ and was highly accurate in the evaluation of the beagles when the fecal samples were examined by a highly trained technician, the second-year veterinary students with less experience and training recorded 11 samples as cyst negative that were positive on the SNAP Giardia fecal antigen test kit. We were the instructors during that class

TABLE 4. Veterinarian and Veterinary Technician Comparison of Ovassay and Centrifugation Techniques for Recovery of Parasite Eggs and Oocysts Using 1.18-SG ZnSO₄ or 1.27-SG Sheather's Sugar Solution

<table>
<thead>
<tr>
<th>GROUP 1—ZnSO₄ (n = 14)</th>
<th>Ovassay</th>
<th>Centrifugation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PARASITES</strong></td>
<td>0 1–10</td>
<td>11–50</td>
</tr>
<tr>
<td>T. canis</td>
<td>0 7</td>
<td>7 0</td>
</tr>
<tr>
<td>T. vulpis</td>
<td>2 9</td>
<td>3 0</td>
</tr>
<tr>
<td>A. caninum</td>
<td>1 12</td>
<td>1 0</td>
</tr>
<tr>
<td>Taenia spp</td>
<td>13 1</td>
<td>0 0</td>
</tr>
<tr>
<td>Eucoleus boehmi</td>
<td>10 4</td>
<td>0 0</td>
</tr>
<tr>
<td>Cystoisospora spp</td>
<td>10 4</td>
<td>0 0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GROUP 2—Sheather's Sugar Solution (n = 13)</th>
<th>Ovassay</th>
<th>Centrifugation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PARASITES</strong></td>
<td>0 1–10</td>
<td>11–50</td>
</tr>
<tr>
<td>T. canis</td>
<td>3 5</td>
<td>5 0</td>
</tr>
<tr>
<td>T. vulpis</td>
<td>2 7</td>
<td>4 0</td>
</tr>
<tr>
<td>A. caninum</td>
<td>7 4</td>
<td>2 0</td>
</tr>
<tr>
<td>Taenia spp</td>
<td>5 8</td>
<td>0 0</td>
</tr>
<tr>
<td>Eucoleus boehmi</td>
<td>10 3</td>
<td>0 0</td>
</tr>
<tr>
<td>Cystoisospora spp</td>
<td>7 6</td>
<td>0 0</td>
</tr>
</tbody>
</table>

²Participants recorded the number of eggs recovered as 0, 1–10, 11–50, or >50 eggs/slide.
period and noted that while some of the samples contained numerous cysts (Figure 2), others contained only a few cysts. We were unable to examine every sample examined by the students, but there were several samples that the students identified as SNAP positive–float negative in which an instructor subsequently identified cysts. It must be noted that, in these investigations, we were unable to ascertain if any of the SNAP positive–float negative samples were in fact true false-positives.

The inability to recognize a few *Giardia* cysts is likely one of the problems encountered by the veterinarians and veterinary technicians who participated in the wet lab. The sample did not contain numerous *Giardia* cysts, and they are smaller than the other parasite eggs and oocysts in the sample. As we walked around the room to assist the participants, we observed cysts in almost every sample evaluated using either ZnSO$_4$ or Sheather's sugar solution. Many of the participants were unable to recognize the small cysts.

Since cyst shedding is notoriously intermittent, the number of *Giardia* cysts recovered on any given day is likely not a good indicator of the level of infection. In a previous investigation, it was noted that dogs could have almost a 10-fold change in the number of cysts recovered on quantitative fecal examinations conducted 3 days apart. In that study, the cysts/g of one control dog went from less than 10 to 3,190 within 3 days. In another dog, the cysts/g count increased from 150 to 44,610 within 3 days. The clinical implication of finding only a few *Giardia* cysts on fecal analysis may be no different from finding hundreds. Therefore, fecal examination from dogs or cats suspected of having giardiasis requires careful microscopic examination in case they are shedding low numbers of cysts.

As noted previously, ZnSO$_4$ has been shown to be the most efficient flotation solution for recovery of *Giardia* cysts and is often used in veterinary practices. The wet lab conducted at the Central Veterinary Conference highlighted a potential problem in using 1.18-SG ZnSO$_4$, even in a centrifugation procedure. Only two of 14 (14.29%) participants using the 1.18-SG ZnSO$_4$ centrifugation procedure correctly recorded that the sample was positive for *Taenia* eggs, while 100% of the participants using the 1.27-SG Sheather's sugar solution recovered *Taenia* eggs from the same sample. This result was not completely unexpected since *Taenia* eggs have an average SG of 1.2251. This indicates that veterinary practices using 1.18-SG ZnSO$_4$ as their flotation solution are likely failing to identify some dogs infected with *Taenia* tapeworms and possibly other parasites that shed heavy eggs, such as *Physaloptera* spp, which have eggs with an average SG of 1.2376. Another investigation that evaluated the SG of a fecal flotation solution indicated that solutions with SGs of 1.22 to 1.35 would be best for routine laboratory use.

If giardiasis is on the differential list of a dog (or cat) with diarrhea, the data indicate that conducting both ZnSO$_4$ centrifugation fecal flotation and a SNAP *Giardia* fecal antigen test may increase the chances of recording a positive finding. However, it must also be remembered that a single negative examination, even if both tests are conducted simultaneously,
does not necessarily rule out giardiasis. Three fecal examinations over a 7-day period using both techniques will almost ensure a correct diagnosis. While using the proper Giardia cyst recovery technique is important, identification of recovered cysts is critical. In the Central Veterinary Conference wet lab, registered veterinary technicians and veterinarians had great difficulty identifying cysts even when informed the samples were positive. Proper training of veterinarians and clinical staff on how to correctly identify Giardia cysts is important and would greatly improve diagnostic accuracy, but training or retraining of personnel already in practices may be difficult on a large-scale basis.

The major question is, “What procedure or procedures should be conducted for routine fecal examinations?” Data from this current study and another previously published study would suggest that the swing-head centrifugation technique using 1.27-SG Sheather's sugar solution is an efficient method of recovering many commonly encountered parasite eggs and oocysts. However, while the sugar solution is effective for many eggs and oocysts, it distorts and/or destroys most Giardia cysts, often rendering them unrecognizable to most veterinarians and technicians (Figure 3). In addition, currently used sugar solutions must be mixed on site (see box on page 7) and some chemical needs to be added (e.g., phenol, formalin) to prevent bacterial growth. Sugar solutions are also sticky and can attract flies. Many practices, therefore, have used commercially available salt solutions for routine fecal examinations, including ZnSO₄. However, as demonstrated in this investigation, a 1.18-SG ZnSO₄ flotation solution may not be able to float parasite eggs with a higher SG.

**CONCLUSION**

Because of the inability of 1.18-SG ZnSO₄ flotation solution to consistently recover heavier parasite eggs, it may be prudent for many veterinary practices to conduct routine fecal examinations using 1.27-SG Sheather's sugar solution. While some salt solutions may be used as a practical alternative, the use of a centrifugation technique will undoubtedly increase diagnostic efficacy. Veterinary practices should also consider the routine use of a hydrometer so that the proper SG of their flotation solution can be assured. In addition, if giardiasis is encountered in the practice area, fecal examinations should include a SNAP Giardia fecal antigen test. The difficulty we noted in the ability of veterinarians, veterinary technicians, and veterinary students to identify Giardia cysts in our studies is likely reflective of the situation in many practices. Therefore, the in-clinic soluble SNAP Giardia fecal antigen Test Kit likely will improve a clinic’s ability to arrive at a correct diagnosis. In addition, the proper recovery and identification of parasites should allow for a more targeted therapeutic approach.

**ACKNOWLEDGMENTS**

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