Evaluating Quikon® Med as a Coccidiocide for Inland Bearded Dragons (*Pogona vitticeps*)

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Abstract

***Isospora amphiboluri* is the most common coccidian isolated from captive bearded dragons. This parasite can cause severe, debilitating disease in juvenile dragons. Most treatment recommendations for *I amphiboluri* are anecdotal and based on the administration of coccidiostatic compounds. Essential oil extracted from oregano (*Origanum vulgare*) has been successfully used as a coccidiocide in poultry and may prove efficacious for reptiles. The purpose of this study was to evaluate the efficacy of a commercial herbal product (Quikon® Med) against *I amphiboluri* in juvenile bearded dragons. Twenty-four juvenile bearded dragons were included in this study and divided into 3 study groups. Group 1 received 6-g Quikon® Med/1-L 0.9% saline solution during the first treatment and 24 g/L during the second treatment. Group 2 received 3 g/L during the first treatment and 48 g/L during the second treatment. Group 3 served as the control during both treatment periods and received only 0.9% saline solution. The treatments were all dosed at 10 mL/kg/d to simulate maintenance fluid intake. Because all of the dragons remained positive after using the first treatment concentration of the commercial product, a second treatment interval was initiated, increasing the Quikon® Med dose. Dragons treated with Quikon® Med had significantly ($P < .05$) higher body weights than the control dragons at the end of the study; however, the treatment had no effect on the coccidia status of the dragons.**

Key words: **bearded dragon; coccidian; oregano; *Pogona vitticeps*; treatment**

Isospora amphiboluri was first identified in Australian *Pogona barbata* in 1962.[1] More than 3 decades later, it was eventually identified in captive inland bearded dragons (*Pogona vitticeps*) from the United States.[2] Adult bearded dragons in which the parasite is found are generally asymptomatic, although diarrhea has been clinically observed. The course of disease in juvenile dragons is more severe, with animals developing life-threatening diarrhea and dehydration. *I amphiboluri* coinfections with adenovirus and dependovirus have also been reported in juvenile dragons, which contribute to the life-threatening disease processes associated with coccidian-infected animals.[3]

Although coccidian parasites are generally considered self-limiting in mammals, this has not been

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apparent with bearded dragons. Since being described, these parasites have become widespread in captive bearded dragon populations because of an absence of effective quarantine programs incorporating routine screening and treatment. Eliminating coccidian parasites in reptiles can be difficult. A primary reason for this is that recommended treatments, predicated on sulfa-based compounds being used to treat infections, are coccidiostats. To effectively eliminate coccidian parasites, a coccidiocide is required.

Oregano is a natural herb that has long been considered to have antibacterial and antifungal properties.[4,5] The emulsified oils of different species of oregano have also been used to control enteric parasites in humans and chickens.[6,7] In chickens, oregano has also found to have a secondary effect, increasing weight gain.

The purpose of this study was to determine the efficacy of a commercial herbal product as a coccidiocide for bearded dragons. A commercial herbal product that makes a label claim as a coccidiocide for birds (Quikon® Med, Bocholt, Germany) (Fig 1) was used for the study. The specific biological hypotheses being tested in this study were: 1) that bearded dragons treated with the commercial product would be significantly less likely to be coccidia-positive than those dragons not offered the product, and 2) bearded dragons infested with coccidia and fed the product would be more likely to gain weight than those infested with coccidia and not offered the product.

Figure 1. Quikon® Med is an herbal product that is recommended for birds. The manufacturer's claim for the product is against bacteria, coccidia, and fungi.

Methods

Twenty-four hatchling bearded dragons were used for the study. The dragons were imported from a bearded dragon breeding facility in Herra Dura, El Salvador. The animals were all prescreened in El Salvador to ensure that they were coccidia positive.

Each dragon was housed separately in an open-top plastic container (Newell Rubbermaid Inc, Wooster, OH USA). Newspaper was used as the substrate. The dragons were offered a diet comprised of crickets, mealworms, and a commercial bearded dragon diet (Fluker Farms, Port Allen, LA USA). The crickets and mealworms were dusted at each feeding with a commercial calcium supplement (Repta-Calcium, Fluker Farms). Chlorinated tap water was provided ad libitum in a plastic resin bowl. Repta-Sun full-spectrum fluorescent bulbs (Fluker Farms) provided a 12-hour photoperiod. The daytime environmental temperature was maintained between 88°F and 94°F (31.1-34.4°C), and the nighttime temperatures ranged from 82°F to 86°F (27.7-30.0°C). The dragons were provided a 7-day acclimation period before initiating the study. The dragons were all weighed to the nearest tenth of a gram before starting the study. During the acclimation period, fecal samples were collected from each dragon daily to confirm the presence of *I amphiboluri* (Figs 2 and 3). Confirmation of the coccidia to species was done with the measurements described by McAllister et al.[2]

After determining that the dragons were *Isospora* positive, the first treatment was started. The bearded dragons were randomly distributed into 3 groups of 8 using a random number generator. The treatment was mixed as a certain weight of Quikon® Med powder (5% *Aetheroleum origami*) per liter of 0.9% saline solution. Group 1 received a dose of 6 g/L, group 2 had a dose of 3 g/L, and group 3 was the control and received 0.9% saline solution. The treatments were dosed at 10 mL/kg/d by mouth for 14 days (Fig 4). The dosing regimen was based on the manufacturer's recommendation for birds and the volume by the baseline maintenance rate of fluids for a reptile. Feces were collected daily with a sterile cotton swab and smeared on a microscope slide with

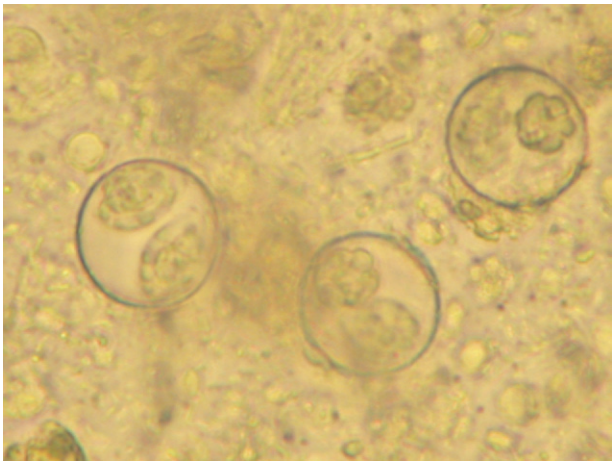

Figure 2. Sporulated *Isospora amphiboluri* found in the feces of a bearded dragon (*Pogona vitticeps*).

Figure 4. Each bearded dragon was dosed with either Quikon® Med or saline solution at a predetermined rate of 10 mL/kg/d.

a drop of 0.9% saline solution. The direct smears were evaluated with light microscopy. Animals were characterized by means of a categorical system: positive or negative. Fecal samples were analyzed for 50 days. Dragons were weighed daily throughout the study.

A second intervention study was performed to evaluate the effect of a higher dose of Quikon® Med. In the second study, group 1 was dosed at 24 g/L, group 2 was dosed at 48 g/L, and group 3 (the control) was given 0.9% saline solution. Again, the treatments were dosed at 10 mL/kg/d by mouth for 14 days. After the treatment period, fecal samples were collected daily for 17 days.

Sample size was calculated for a binomial proportion under the following assumptions and criteria: that the proportion of *Isospora*-positive bearded dragons in the Quikon® Med treatment groups would be no greater than 0.2 after treatment, that the proportion of *Isospora*-positive dragons in the saline treatment group was no less than 0.9, that the $\alpha = .05$, and the power = 0.89. The 95% binomial confidence intervals (CI) were calculated for the proportion estimates of the different treatment groups. Friedman's nonparametric analysis of repeated measures was used to evaluate the dragons for differences in body weight over the course of the study. If a difference was found, then Rhyne and Steele's method was used to compare among group differences. Values of $P < .05$ were considered statistically different. Statistical analysis was performed with SPSS 11.0 (SPSS, Inc, Chicago, IL USA).

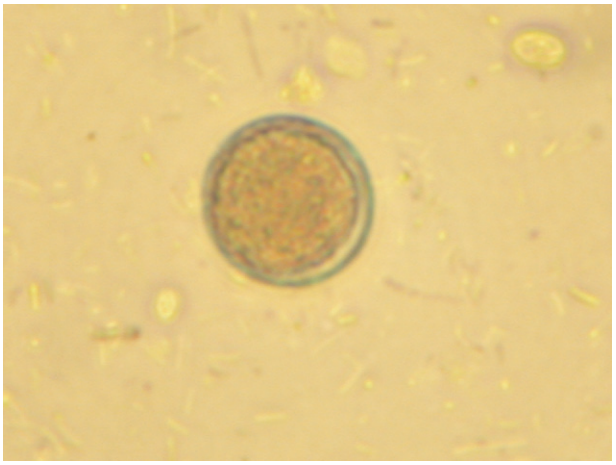

Figure 3. An unsporulated *Isospora amphiboluri* found in the feces of a bearded dragon.

Results

All of the dragons remained *Isospora* positive throughout the study. The first intervention study was conducted from the first day the Quikon® Med mixture was administered to the day before treatment 2, spanning a total of 65 days. A total of 255 fecal specimens were collected on 56 of the 65 days in this trial. The number of positive samples per group was as follows: group 1 (6 g/L), 66 of 77 samples were positive (85.7%; 95% CI, 78-94); group 2 (3 g/L), 100 of 107 samples were positive (93.5%; 95% CI, 88-99); group 3 (saline solution) = 51 of 71 samples were positive (71.8%; 95% CI, 62-82). Based on the 95% CIs, feces collected from the control dragons were less likely to be *Isospora* positive than the dragons in group 2 (3 g/L).

A total of 128 fecal samples were collected from the bearded dragons for the second trial. The number of positive samples per group was as follows: group 1 (24 g/L), 27 of 42 samples were positive

(64.3%; 95% CI, 50-79); group 2 (48 g/L), 41 of 44 samples were positive (93.2%; 95% CI, 86-100); group 3 (saline solution): 23 of 42 samples were positive (54.8%; 95% CI, 40-70). Based on the 95% CIs, dragons in group 2 (48 g/L) were more likely to be *Isospora* positive than the control animals. Using the 95% CIs to compare each group with itself over both treatment periods suggests that shedding for the dragons was not different by treatment.

All 3 groups were very similar in body weight at the beginning of the study: group 1, 7.1g; group 2, 7.2g; and group 3, 7.0g. By the end of the second trial, however, the weights were significantly different ($P < .05$). Group 1 gained an average of 10.79 g, for an average weight of 17.93 g; group 2 gained an average of 14.16 g, for an average weight of 21.36 g; group 3 gained only an average of 6.6 g, for an average weight of 13.16 g.

Discussion

Coccidiosis is a major concern in the poultry industry, with losses approaching $1.5 billion dollars annually.[8] The primary reason for the heavy losses is associated with the intense production methods practiced by producers. Bearded dragon producers are also generally forced to maintain high stocking densities of dragons within a small, confined space, and this practice likely serves as a mechanism for the widespread dissemination of the parasites between animals. In addition to instituting biosecurity methods to diminish the transmission of these parasites, such as using appropriate disinfection and minimizing direct and indirect contact between coccidia-positive and coccidia-negative animals, there is a need to identify anticoccidial therapeutics that can be used to control these parasites.

The essential oils of oregano have been found to have antimicrobial, antifungal, and antiparasitic properties.[4-7] Phenolic compounds within the oils have been associated with these protective effects. The mechanism of action for these compounds is not well understood, but it appears that they can disrupt the cytoplasmic membrane of different organisms, making them more permeable to the environment.[9] In some cases the oils can even lead to the disintegration of the outer membrane of the organism. These phenolic compounds can also have negative effects on the enterocytes, so there may be adverse effects to the treated animals.

Oregano has been used in both humans and birds as a method to control enteric parasites. In humans, 200 mg of emulsified oregano oil (*Oreganum vulgare*) 3 times daily for 6 weeks was found to eliminate *Blastocystis hominis*, *Entamoeba hartmanni*, and *Endolimax nana* in 77% (10/14) of cases.[6] An additional 3 humans were found to have reduced disease symptoms.

In poultry, oregano was found to significantly reduce the disease conditions associated with *Eimeria tenella* infections. This was measured in the form of improved body weight and feed conversion ratios in comparison with infected, untreated controls. The differences observed with the oregano group, however, were less protective than those observed with an anticoccidial drug. There was also a difference in fecal shedding of *E tenella* between control and treatment groups.[7] Oregano-treated groups shed fewer oocysts than controls but more than the treatment group receiving the anticoccidial drug. In the dragon study, we could not measure the number of oocysts per a defined quantity of feces because of the variability in fecal sample sizes between animals and days. However, this should be investigated in future studies to determine if a difference existed.

Although the Quikon® Med did not have any effect on the viability or shedding of *I amphiboluri*, it is worth mentioning that there were significant differences in body weight detected in the study, similar to that reported for poultry. The apparent growth-promoting properties of oregano are still preliminary and require further research. It is possible the effects identified in this study may be associated with some of the claims made by the manufacturer. The manufacturer claims that their product has bactericidal, coccicidal and fungicidal properties. The value of the product may be analogous to food-meat producers using antibiotics at subtherapeutic levels as growth promotants in livestock. If oregano truly has bactericidal or fungicidal properties in bearded dragons, it may be used as a dietary supplement to improve growth rates or control the microflora.

To date, there has been no work defining the epidemiology of *I amphiboluri* in bearded dragons. In this study, all of the dragons remained *I amphiboluri* positive throughout the study. Interestingly, the parasite was shed in the majority of samples being tested, suggesting that transient shedding may be uncommon with this parasite. The results also suggest that the frequency of shedding may remain consistent between animals. For example, even though dragons in group 2 were treated during both treatment periods, and the second treatment was at the highest dosing interval, the animals consistently had the highest frequency of positive samples. Dragons in group 2 were also more likely to have a higher frequency of shedding compared with the controls.

These findings, in addition to the fact that there were no differences in the 95% CI levels between the treatment studies for each group, suggest that *I amphiboluri* shedding among animals is consistent.

The location of *Eimeria* spp in the intestinal tract of poultry is different from the location of *I amphiboluri* in dragons. In poultry, *Eimeria* reside in the ceca,[10] whereas *I amphiboluri* is found in the small intestine of the dragon.[2] The difference in intestinal location, and therefore microflora and microhabitat, may have an affect on the efficacy of the product. The claims of the manufacturer suggest that the product is effective against *Eimeria* spp. It is possible that the drug is not effective against other genera of coccidia, such as *Isospora*. Other apicomplexans in reptiles, such as *Cryptosporidium* spp, are not responsive to standard anticoccidial compounds.

Coccidia in bearded dragons continue to be a significant cause of morbidity and mortality. Finding an effective anticoccidial drug to eliminate *I amphiboluri* is a priority for both herpetoculturists and veterinarians. Although the commercial product used in this study was not effective at eliminating coccidia, we could not determine if it had an affect on the number of oocysts being shed. The increased body weights recorded in the treated dragons do suggest that some benefit is being derived from the treatment, and this deserves additional study.

Acknowledgments

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