Executive Summary

Work carried out in 2006 by researchers at the Ontario Veterinary College indicated that coccidia (Isospora suis) infections are a common occurrence on Ontario swine farms in pigs at 7 to 21 days of age. Furthermore, infections are associated with both diarrhea and reduced growth rates. However, since the impact of infections was only evaluated in animals up to 21 days of age, the total impact of coccidia infections may be significantly greater. This project therefore endeavored to determine the impact of coccidia on growth up to 8 weeks of age.

Initial work indicated that the optimal, practical, protocol for defining the coccidia-infection status of pigs from 1 to 8 weeks of age was to examine fecal samples at weeks 2, 3 and 5 of life. In order to determine the impact of coccidia on growth up to 8 weeks of age, three representative swine farms were selected that had a coccidia problem. Between May and September 2007, fecal samples were collected from 218 randomly selected pigs on the three farms at the three stated ages. The weights of all 218 pigs, and all their littermates, were recorded at 1, 2, 3, 4, 5 and 8 weeks of age. Quite surprisingly, at 4 weeks of age, pigs that were detected
positive for coccidia at 2 or 3 weeks of age were an average of 435 g lighter than pigs that originated from litters that were negative for coccidia (p=0.065). Similarly, at 5 weeks of age, pigs that were detected positive for coccidia at 2 or 3 weeks of age were an average of 703 g lighter than pigs that originated from litters that were negative for coccidia (p=0.007). Coccidia infections therefore had a significantly greater impact on growth than previously thought.

Finally, discussions with a number of swine veterinarians in Ontario indicated that the following two treatment protocols are often used for preventing coccidiosis in pigs: (a) ad libitum provision of Deccox mixed with oral iron in the creep area throughout the suckling period, and (b) single treatment with Clinacox in the first week of life. Since no drug is currently licensed in Canada for treatment of coccidia infections in pigs, these two treatment regimens were evaluated on farms with a coccidia problem. Unfortunately, neither treatment reduced the risk of coccidia infections, or the risk of diarrhea, in pigs aged 7-21 days. Similarly, neither treatment had any beneficial effect on growth rates during this period.

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**Problem**

In 2006, a study was carried out on 50 farms in southwestern Ontario to determine the prevalence and impact of *Isospora suis* (coccidia) in pigs at 7 to 21 days of age. Coccidia were found on 70% of the farms, and litters that had coccidia were 4-times more likely to have
diarrhea than non-infected litters. In addition, coccidia-positive farms had a mean standardized weaning weight that was 400 g lighter compared to non-infected farms (Webster et al., 2006). Collectively, these data indicated that coccidia infections occur commonly on Ontario swine farms and are a cause of diarrhea.

In most countries, the only treatment available for coccidia infections in pigs is Baycox (toltrazuril). However, in 2005 the drug was banned in Canada, leaving pork producers without an effective drug against coccidia. In order to maximize the chance of an alternative drug being licensed for use against coccidia in Canadian pigs, information on the total impact of coccidia infections is required. Since the 2006 Ontario study sampled pigs up to 21 days of age, it may have underestimated the total impact of coccidia. A study was therefore required to determine the impact of coccidia infections up to 8 weeks of age. In addition, since a limited number of drugs are currently used off-label in Canada to treat coccidia infections in pigs, it was important to evaluate these treatment regimens in controlled clinical trials.

Objectives

1. To determine the impact of coccidia on post-weaning performance.

2. To investigate the efficacy of control methods to reduce the effects of coccidia in endemically infected herds.

Materials and Methods

Objective 1:

- In previous work, shedding of coccidia oocysts was only examined in pigs up to 3 weeks of age. In order to address Objective 1, we needed to first determine the optimum time(s) to
sample pigs up to 8 weeks of age to define their coccidia-infection status. A pilot study was therefore carried out on a farm with a coccidia problem:

- Rectal fecal samples were collected from 188 randomly selected pigs, representative of animals from 1 to 8 weeks of age.
- All fecal samples were examined for coccidia oocysts using the Cornell-Wisconsin flotation method (Egwang and Slocombe, 1982), and the number of oocysts determined per gram of feces.

For the main study, to determine the impact of coccidia on growth rates up to 8 weeks of age, three representative swine farms were selected that had a coccidia problem. The herds had a similar sow capacity (230 to 350). A sample size calculation indicated that 72 litters were required in order to find a 5% difference in mean weight between coccidia-positive and coccidia-negative pigs with 80% power and rho 25%.

- Between May and September 2007, rectal fecal samples were collected from 218 randomly selected pigs on the three farms at 2, 3 and 5 weeks of age. In total, 655 fecal samples were collected from 218 pigs belonging to 72 litters.
- All fecal samples were examined for coccidia oocysts as before.
- The weights of all 218 pigs, and all their littermates, were recorded at 1, 2, 3, 4, 5 and 8 weeks of age. In total, 3928 weight data were recorded.

**Objective 2:**

- Two coccidia-treatment regimens currently used by swine veterinarians in Ontario were evaluated on farms with a coccidia problem; one farm was used to evaluate the efficacy of a Deccox (decoquinate) regimen, a second was used to evaluate a Clinacox (diclazuril)
regimen.

- In order to evaluate the Deccox regimen, oral iron (Sweet Iron) was mixed 5:1 with Deccox 6% Premix and 72 g of the mixture was provided *ad libitum* in the creep area to 15 litters from days 3 to 15 of age. Each of the 15 litters in the control group received 72 g of oral iron only, administered in the same manner on the same days of age.

- In order to evaluate the Clinacox regimen, the drug was administered orally at a dose of 20 mg/kg body weight, on one occasion, to all pigs in 40 litters, on day 2 or 3 of life. The control group comprised 40 untreated litters.

- For both studies, fecal samples were collected from 3-5 pigs per litter on two occasions from 7-21 days of age and examined for coccidia oocysts. The diarrhea status of each sample was also determined. Lastly, growth rates were determined for all pigs up to 21 days of age. ANOVA analysis was used to determine if treatment had a significant impact on growth rates, the risk of coccidia infection and/or the risk of diarrhea in pigs up to 21 days of age.

Project Results

**Objective 1:**

- **Pilot study:**
  - Amongst 188 fecal samples from 188 pigs, 34 were positive for coccidia oocysts.
  - 65% of all positive samples were from pigs aged 15-24 days of age.
  - No pigs were detected infected under 15 days of age or over 40 days of age.
  - The mean number of oocysts per gram of feces for pigs aged 15–24 days was 390
(95% confidence interval [CI] = 121–658), while the mean for pigs at 25–56 days of age was 41 (95% CI = 11–71).

- When considered with data collected from multiple Ontario farms in 2006, the results indicated that the optimal, practical protocol for determining the coccidia-infection status of pigs up to 8 weeks of age was to sample pigs at 2, 3 and 5 weeks of age.

**Main study:**

- 162 of the 218 pigs were detected positive for coccidia on at least one occasion. Positive pigs occurred approximately equally on all three farms.

- When controlling for age, weight and farm using linear regression at the litter level:
  - At 4 weeks of age, pigs that originated from litters that were positive for coccidia at 2 or 3 weeks of age were an average of 435 g lighter (95% CI = -27-897 g) than pigs that originated from litters that were negative for coccidia (p=0.065).
  - At 5 weeks of age, pigs that originated from litters that were positive for coccidia at 2 or 3 weeks of age were an average of 703 g lighter (95% CI = 195-1,212 g) than pigs that originated from litters that were negative for coccidia (p=0.007).
  - At 8 weeks of age, pigs that originated from litters that were positive for coccidia at 2 or 3 weeks of age were not significantly different in weight from pigs that originated from litters that were negative for coccidia (p=0.78).

- When controlling for age, weight and farm using linear regression at the pig level:
  - At 8 weeks of age, pigs that were only detected positive for coccidia at 5 weeks of age were not significantly different in weight from pigs that were never detected positive for coccidia (p=0.8).
Objective 2:

- Evaluation of Deccox (decoquinate) provided *ad libitum* - Pigs in the 15 litters that were medicated with Deccox and oral iron had an average daily weight gain (DWG) of 237 g compared to an average DWG of 226 g for pigs in the 15 litters provided with just oral iron. The ANOVA analysis did not show a statistical difference in growth rates between the two groups. Likewise, shedding of coccidia oocysts and diarrhea scores were not significantly different between the two groups.

- Evaluation of Clinacox (diclazuril) single treatment - Pigs in the 40 litters that were treated with Clinacox had an average DWG of 249 g compared to an average DWG of 237 g for pigs in the 40 control litters. This was not statistically different. Likewise, shedding of coccidia oocysts and diarrhea scores were not significantly different between the two groups.

Milestones

*May 31, 2007* – Completion of pilot study to determine the optimum sampling strategy for defining the coccidia-infection status of pigs from 1 to 8 weeks of age.

*August 31, 2007* – Completion of on-farm data collection to determine the impact of coccidia infections on the growth of pigs up to 8 weeks of age.

*August 31, 2007* – Completion of clinical trials to evaluate the activity of Clinacox, and Sweet Iron + Deccox, as preventive treatments for coccidia infections.

*October 25, 2007* – Completion of data analyses to determine the impact of coccidia infections on growth up to 8 weeks of age.
Discussion

Swine coccidia infections have generally been assumed to only occur in suckling pigs from days 7-21 of age. However, this study has demonstrated that infections may occur in weaned pigs up to 5 weeks of age. The reason that no coccidia were detected in pigs until 15 days of age suggested that infections on the pilot study farm were not acquired until 2 weeks of age. It should, however, be noted that shedding of coccidia oocysts from 7–14 days of age was a common finding on Ontario farms in 2006 (Webster et al., 2007). Examination of the level of shedding of coccidia oocysts in feces indicated a substantial reduction after 24 days of age. Thus, collectively, along with earlier data from Ontario farms, the results indicated that the optimum, practical regime for determining the coccidia-infection status of pigs up to 8 weeks of age was to sample animals at 2, 3 and 5 weeks of age. Using this sampling regime, a study was carried out on three Ontario farms with a coccidia problem to determine the impact of coccidia infections on growth up to 8 weeks of age. Quite surprisingly, at 4 weeks of age, pigs that originated from litters that were detected positive for coccidia at 2 or 3 weeks of age were an average of 435 g lighter than pigs that originated from litters that were negative for coccidia (p=0.065). Similarly, at 5 weeks of age, pigs that originated from litters that were detected positive for coccidia at 2 or 3 weeks of age were an average of 703 g lighter than pigs that originated from litters that were negative for coccidia (p=0.007). However, at 8 weeks of age, pigs that were detected positive for coccidia at 2 or 3 weeks of age were not significantly different in weight from pigs detected negative for coccidia (p=0.78). It would appear that a compensatory growth mechanism is likely responsible for this latter finding.

Finally, in work that was carried out to evaluate the efficacy of coccidia treatments that are currently used by swine veterinarians, the activity of Deccox was evaluated when
administered *ad libitum* with oral iron in the creep area. Unfortunately, no significant beneficial activity was demonstrated against coccidia, most likely because pigs did not consume adequate amounts of drug when administered in this manner. Similarly, single treatment of pigs in the first week of life with Clinacox did not show significant beneficial activity. Thus, although the drug is closely related to Baycox (toltrazuril), it does not appear to be as potent a coccidiostat, consistent with work elsewhere (Mundt et al., 2003).

**Conclusions:**

1. When pigs were examined from 1 to 8 weeks of age for coccidia (*I. suis*), 65% of all positive samples were detected at 15 to 24 days of age. However, the range in age that pigs were detected infected was 15 to 40 days.
2. Data obtained in this and earlier work indicated that the optimal, practical, protocol for defining the coccidia-infection status of pigs up to 8 weeks of age was to examine fecal samples from animals at weeks 2, 3 and 5 of life.
3. Coccidia infections detected at 7-to-21 days of age were shown to have a significant negative impact on weights at 4 and 5 weeks of life.
4. Deccox (decoquinate) did not have significant activity against coccidia infections when administered *ad libitum* with oral iron in the creep area.
5. Clinacox (diclazuril) did not have significant activity against coccidia infections when administered on one occasion to pigs on day 2 or 3 of life.

**Training of students**

- Cory Todd, a BSc student at the University of Guelph, was employed full time from May to
August 2007, inclusive, to assist the project.

- Since September 2006, Andrea Aliaga-Leyton, DVM, has been registered full time as an MSc student in the Department of Population Medicine, University of Guelph. Andrea has managed all the described work, and has been partly funded by this project.

**Dissemination of information**


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References

