Prevention and treatment of parasitic infections in organic pigs

H.A.M. Spoolder[1], H.E. Mejer[2], H.M. Vermeer[1], B.G. Meerburg[1] , M. van Krimpen[1] and H.A. Kijlstra[1]

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Abstract

Organic and free range pigs are potentially exposed to a wider range of parasites and zoonotic challenges. The livestock Subproject QLIF addresses 4 strategies to combat these challenges, and the present paper describes the initial results. Rodent control is the first strategy, and a survey concludes that Salmonella *and* Campylobacter *infections were encountered in house mice and Norway rats, but not in other species.* T. gondii *antibodies could be detected in 6.4% of the blood samples taken from 235 wild small mammals. To reduce the presence of rodents around farms, the use of live-traps may be a good alternative for the use of rodenticides on organic farms. A second strategy is aimed at directing pig dunging behaviour in such a way that contact with (infected) faeces is minimised. The study showed that a rooting area resulted in a cleaner outdoor are and an extra outdoor drinker led to a cleaner area around the drinker, but to a dirtier indoor area. However, no difference in* Ascaris suum *infection were found. The nutritional strategy tested showed that pure inulin appeared the most effective as* Oesophagostomum dentatum *presence was reduced by 91%. Finally, as part of Strategy 4, a mixture of dried* Thymus vulgaris*,* Melissa officinalis *and* Echinacea purpurea *in a dosage of 5% in the diet showed to be preventive against a mild round-worm infection. The same mixture, however, was not effective in a lower dosage (3% in the diet) against a serious round-worm infection. Work is continuing to develop the above strategies further.*

Introduction

Organic and many “low input” production standards for pigs require outdoor access. As a result animals are exposed to a wider range of potential endo- and ectoparasite infection sources and challenges (in particular faeces from small mammal vectors) than animals kept under conventional indoor conditions. Organic regulations claim that animal health should be assured through good management and prevention practices, instead of conventional (allopathic) medication. However, effective alternative methods for parasite control in pigs are almost completely missing, and use of conventional antiparasitic drugs is the rule on organic farms (Baumgartner et al., 2001).

It is therefore essential to develop improved management strategies for outdoor systems (e.g. improved rodent control). WP’s 4.1 and 4.2 review 4 preventative and curative strategies that will be helpful in reducing the incidence of parasitic and

[1] Animal Sciences Group of Wageningen University and Research Centre, PO Box 65, 8200 AB, Lelystad, The Netherlands, E-mail: Hans.Spoolder@wur.nl; Herman.Vermeer@wur.nl; Bastiaan.Meerburg@wur.nl; Aize.Kijlstra@wur.nl. Internet www.asg.wur.nl

[2] Dept. of Vet. Pathobiology, Royal Veterinary and Agricultural University, KVL, 100 Dyrlaegevej, DK 1870, Frederiksberg C, DK, hem@kvl.dk

zoonotic infections in pigs: rodent control, dunging behaviour, carbohydrates and herbal remedies.

Rodent control

The first strategy studied is to reduce the infection pressure through a tighter control of vectors such as rats and mice. Livestock farming can be prone to rodent infestations as it provides unlimited amounts of shelter, water and food to commensal rodents. The aim of this strategy is to obtain a better understanding of the risk of rodent presence on farms for transmission of pathogens to (organic) livestock in the Netherlands and to investigate their potential influence on the safety of food products we consume.

This work is carried out as WP4.1.3, and has three main objectives.

Objective 1 was to provide insight into the contamination levels of wild rodents (and insectivores) with *Salmonella, Campylobacter* and *Toxoplasma gondii* on organic livestock farms, as these food-borne pathogens cause a high disease burden for humans.

Objective 2 was to find a method for sustainable though effective rodent management in (organic) livestock farming.

Objective 3 was to investigate the effect of stringent rodent control on *Toxoplasma* seroprevalence in slaughter pigs.

The following results are obtained.

Contamination of wild rodents

Rodents and insectivores (n=282) were trapped on ten organic farms (nine pig farms, one broiler farm) by using live-traps between August-October 2004. *Salmonella* and *Campylobacter* infections were encountered in house mice (8 of 83 Campylobacter-positive and 1 of 83 Salmonella Livingstone-positive) and Norway rats (1 of 8 Campylobacter-positive), not in other species. The results showed that *T. gondii* antibodies could be detected in 6.4% of the blood samples taken from 235 wild small mammals. Highest seroprevalence (9.1 %) was found in the White toothed shrew.

Comparing rodent control methods

During the autumn of 2005 we set up an experiment in 20 organic pig farms whereby two different rodent control methods were compared. Ten farms used conventional rodenticides and ten farms used live traps. The amount of rodents present on the farms before and after the experiment was assessed by measuring the amount of non-poisonous pealed oats taken up from bait boxes. The efficacy of rodenticides versus life traps was not significantly different. This indicates that the use of live-traps may be a good alternative for rodent control on organic farms.

Effects of rodent control on Toxoplasma

In the first experiments from this workpackage we showed that transfer of *Salmonella* or *Campylobacter* from rodents to livestock cannot be ruled out but is probably not the major transfer route. In the last part of the project we therefore decided to confine ourselves to the effect of stringent rodent control on transfer of *Toxoplasma* infections to slaughter pigs. On a selected number of organic pig farms (n=3), with a rodent control problem and presence of *Toxoplasma* infected pigs we performed stringent rodent control and followed *Toxoplasma* seroprevalence at slaughter. Although the experiment has not been completed, the first data indicate that adequate rodent control is associated with a decrease in *Toxoplasma* seroprevalence in the slaughter pigs.

Dunging behaviour and cleaning of pens

The second strategy deals specifically with the contamination of finishing pigs on farms with outdoor access to concrete runs, and the transmission of parasitic eggs between pigs and pens. Key factor is that transmission occurs through faeces. The approach uses the pig's intrinsic need to keep its lying area separate from the dunging area: if dunging behaviour can be properly directed, the area in the pen which is soiled will be strongly reduced in size. In theory, this serves two purposes: it reduces the risk of contact between pigs and faeces, and it facilitates the cleaning of an infected area.

Ascaris is the most prevalent helminth on organic farms (Carstensen et al., 2002). It is transmitted mainly via the dung of infected pigs, but is only infectious to other pigs after an incubation period in the dung of at least 4 weeks.

Effect of rooting area design on dunging behaviour

In WP4.1.1, 8 groups of 14 pigs were allocated to one of 4 treatments in 4 batches of 4 months. A 2x2 factorial design was used. The treatments are randomly assigned to the 8 pens of the finishing pig building. They were designed to provide increasingly strong stimuli in the outdoor run to direct dunging behaviour towards the part of the run which is furthest from the outside pen wall. This location is easiest to clean manually. The outdoor runs measured 4 x 4 m with 50% part slatted concrete floor with open pen divisions halfway down the length of the pen, on the run half which is furthest from the pen wall (and nearest to the outside inspection passage). In experiment 1 (batch 1 and 2) the factors were the presence/absence of a rooting area and the presence/absence of a drinking bowl on the outdoor run. In experiment 2 (batch 3 and 4) the factors were a separate exit/entrance or a combined exit/entrance and the presence/absence of a playing device as environmental enrichment. In the second week of each finishing period, infectious *Ascaris* eggs were spread on the dunging areas of the outdoor run in the first experiment. In the second experiment only half of the pigs of each pen were infected orally. A standardised protocol will be used to provide minimal but regular cleaning of the outside area. At the end of each finishing period, all pens will be cleaned and disinfected thoroughly.

The study showed that a rooting area resulted in a cleaner outdoor are and an extra outdoor drinker led to a cleaner area around the drinker, but to a dirtier indoor area. Unfortunately, no difference in *Ascaris* infection was found between these four treatment combinations.

Ongoing work on cleaning of pens

Regular (every three weeks) cleaning is more likely to achieve an *Ascaris* free status without medication (Roepstorff and Nansen, 1994), but this is time consuming and often unpractical. Cleaning once during a batch of pigs might be a way to break the lifecycle of *Ascaris*. Therefore, in WP4.1.2, the hypothesis will be tested that the overall worm burden for organic finishing pigs can be reduced in a practical way by cleaning the outdoor run once, at a time just before the eggs have become infectious. During 2006 and 2007 4 batches of 120 pigs will be tested. Eight groups of 15 pigs will be allocated to one of 2 treatments. The treatments are randomly assigned to the 8 pens of the finishing pig building. The pens have 4 x 4 m outdoor runs with 50% part slatted concrete floor. They are designed to provide strong stimuli in the outdoor run to direct dunging behaviour towards a limited part of the run. The two treatments are 'no cleaning' and 'thorough cleaning at week 10 (of 16)'. At the start at 25 kg half of the pigs per pen are infected with worm eggs (mixed in the feed). The batches of 8 groups will be repeated 4 times over one 16 month period (32 groups, 8 replicates per treatment, a total of 480 pigs). At the beginning of each finishing period, 7 artificially infected piglets will be added to the group to provide a controlled and identical level of infection in each group. The 8 non infected pigs serve as focal animals. A standardised protocol will be used to provide minimal daily cleaning (mucking out) of the area. At the end of each finishing period, all pens will be cleaned and disinfected thoroughly. At the end at a slaughter weight of 110 kg the non infected animals are examined at the slaughterhouse for the infection with *Ascaris*.

Carbohydrates

The third strategy is to use carbohydrate sources with high contents of so-called FOS (fructooligosaccharide). The hypothesis is that these will significantly reduce female worm fecundity and worm numbers of both *Oesophagostomum* and *Trichuris* in pigs without affecting pig growth or production costs.

Earlier studies have shown that fructans that are easily fermented by some beneficial bacteria in the caecum and colon may influence parasite egg excretion and parasite establishment and persistence. The mechanism is not known but it is hypothesised that the fermentation changes the physico-chemical properties of the intestinal contents of the hind gut and that this is detrimental to the parasites. One highly effective source of fructans is the commercially available product called inulin (Raftilin HP®, Orafti). However, it is very expensive and of little relevance for the organic pig producer. Inulin is primarily produced from chicory roots and studies have shown that feeding dried chicory roots to pigs may also affect helminth infections in pigs.

Methodology

WP4.1.4 is divided into 2 experimental trials and 1 on farm trial validating the findings from the first 2 trials. In the trial 1, 7 groups of pigs (n=8/10) pigs were infected twice weekly with large round worms (*Ascaris suum*), whip worms (*Trichuris suis*) and nodular worms (*Oesophagostomum dentatum*) from week 0-7. The pigs were fed an organic control diet of barley, wheat, oats, peas, soybeans, rape seed cake, and minerals weeks -2 to 5. Weeks 7-11, part of the cereals were substituted with dried chicory roots (15%, 25% or 35% of the daily energy intake), dried Jerusalem artichokes (25%, also rich in fructans) or potato starch (25% or 35%). The last group remained on the control diet throughout the trial. All pigs were slaughtered for worm recovery week 11.

In the second trial, 5 groups of 10 pigs were infected twice weekly with large round worms (weeks 0 to 7) and nodular worms for (weeks 2 to 7) while fed a control diet of ground barley, protein and minerals. Week 7, 3 groups were given a diet where part of the barley was substituted with dried chicory roots (38% of the feed or approx. 35% of energy intake) for 1 week (weeks 7-8), 2 weeks (week 7-9) or 4 weeks (week 7-11) before they were returned to the control diet. The fourth group was given a diet where part of the barley was substituted with pure inulin (19% of the energy intake). Overall fructan were 16-17% in both the chicory and inulin diets. The fifth group remained on the control diet. All pigs were slaughtered for worm recovery week 11.

Results

The 2 trials only showed an effect on the egg excretion and worm burdens of the nodular worms. The reason may be that the adult large round worm establishes in the proximal small intestine were fermentation does not take place. The front end of the whip worm is partially embedded in the intestinal wall of the caecum and colon and this may provide some protection. In contrast, the adult nodular worms may be more susceptible as they move freely in the intestinal contents of the hind gut. The nodular worm infections appeared negatively affected by the whip worms and the latter was therefore omitted from the second trial.

Dried chicory roots were more effective against the nodular worm than the Jerusalem artichokes. Also fructans appeared more effective than starch. Combined with previous experiments it also appears that the other feed components may modulate the efficacy of the easily fermentable carbohydrates. In the second trial, egg excretion was almost completely eliminated within two days but once the dried roots were removed from the diet egg excretion increased again within 2 weeks. The 35% dried chicory reduced nodular worm establishment by 74-82% in the 2 trials. Statistically 1, 2, and 4 weeks of feeding with chicory was equally effective in reducing worm burdens. The pure inulin appeared the most effective as worm burdens were reduced by 91% perhaps reflecting a more effectively fermentation compared to chicory.

Ongoing work

Based on the above it will be most relevant to the organic farmers to target sows in the on farm trial as older animals have the overall highest infection levels with nodular worms. It is therefore planned to follow the egg excretion patterns of sows during and after a short (2 weeks?) feeding period to evaluate if environmental contamination can be reduced. However, due to unresolved production problems the quality of the last batch of dried chicory roots is below standard. The trial has therefore been delayed until further supplementary root samples have been analysed and compared to determine if and how the dried roots can best be used.

Herbal medication

Finally, the fourth strategy investigates the use of herbal medication to combat infections with round-worm (*Ascaris suum*) as an alternative to chemically produced medicines like benzimidazoles, levamisole or macro cyclic lactones.

Herb mixes seem to be able to reduce round-worm pressures. A mixture of dried *Thymus vulgaris, Melissa officinalis* and *Echinacea purpurea* in a dosage of 5% in the diet showed to be preventive against a mild round-worm infection. The same mixture, however, was not effective in a lower dosage (3% in the diet) against a serious round-worm infection.

The mode of action of the tested herbs was probably based on their anti microbial activity that improved general gut health. The mode of action of this herb mixture can be broadened by the addition of black tea. Black tea contains tannins that seem to prevent round-worm to attach to the gut wall and to develop from worm egg phase to adult round-worm in the pig. Until now, we don’t know whether the earlier tested herb mixture, without or with addition of black tea, in a lower dosage is also effective in preventing round-worm infections in pigs.

Methodology

As part of WP4.2.1 an experiment has started to test the preventive effect of addition of a herb mixture to the diet of *Thymus vulgaris* (1%), *Melissa officinalis* (1%) and *Echinacea purpurea* (1%), with or without addition of black tea (1%) against a mild *Ascaris Suum* infection in growing finishing pigs, compared with a negative (no treatment) or a positive control (treatment with Flubendazole).

In this experiment 32 individually housed pigs are allotted to one of four treatments (8 pigs per treatment):

1) Negative control group; no treatment after infection with *A. suum*;

2) Positive control group; treatment with conventional medication (Flubendazole) after infection;

3) Herbs group A; treatment with Thymus (1%), Melissa (1%) and Echinacea (1%) after infection;

4) Herbs group B: herbs of treatment 3 + black tea (1%) after infection.

Active components (phenols) of herbs and diets will be analysed. Initial weight of the pigs is about 25 kg and absence of *Ascaris* at the start will be checked by faecal egg counts. Before infection, pigs of treatment 3 and 4 were fed herb-rich diets during 14 days. The other pigs are fed a common organic starter diet during the whole experimental period. Then, pigs are mild infected by oral administration of 200 worm eggs/pig over 5 days. Herb diets will be supplemented until 22 days after infection. On day 42 after infection, Flubendazole medication is given to pigs of treatment 2. All pigs are slaughtered on day 50 after infection (± 75 kg life weight), after which number of worms in the GIT are countered. The experiment starts on the 25th of December ’06 and finishes on the 21st of February ’07.

When treatment 3 and/or 4 seems to be effective in preventing a mild *Ascaris* infection, we will test the herbs under practical conditions (phase 2). Therefore, 4 organic pig farms (2 with low and 2 with high slaughter scores for liver rejection) will be selected to test the herbs versus conventional treating against *Ascaris suum*.

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Reference

A list of references is available from the first author.