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A Survey of Gastrointestinal Pig Parasites on Free-range, Organic and Conventional Pig Farms in The Netherlands

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ABSTRACT

The prevalence of gastrointestinal parasites in suckling piglets, weaners, fattening pigs and sows was studied from November 2001 to October 2002 on 16 free-range farms (FRF), 11 organic farms (OF) and 9 conventional farms (CF) by means of faecal examinations of composite samples. Each farm was visited four times with a 3-month interval. Infections with coccidia were found on 43.8% of the FRF, 90.9% of the OF and 66.7% of the CF. Sows had the highest prevalence, particularly on FRF (87.5%) and OF (80%). *Ascaris suum* was present on 50% of the FRF, 72.7% of the OF and 11.1% of the CF, whereas fattening pigs on FRF (42.9%) and OF (54.5%) had the highest prevalence. *Oesophagostomum* spp. were observed on 25% of the FRF, 27.2% of the OF and 22.2% of the CF. The infection was most prevalent in the sows on all farm types: 37.5% on FRF, 30% on OF and 22.2% on CF. *Trichuris suis* was found on 37.5% of the FRF, 36.4% of the OF and 11.1% of the CF. Again, this infection was most prevalent in the sows, particularly on the FRF (50%) and OF (30%). No other gastrointestinal parasite species were found and no clinical signs were observed. No seasonal trends could be distinguished. In many cases, when an age group on a farm was positive for a certain parasite, it remained so during the whole study. This indicates that this parasite was really 'endemic' on that farm.

The results of this study demonstrate that the prevalence of helminth infections of pigs on farms with outdoor facilities is higher than in pigs on conventional farms.

Keywords: *Ascaris suum*, conventional farms, free-range farms, *Oesophagostomum* spp., organic farms, pig helminths, *Trichuris suis*

Abbreviations: FRF, free-range farms; OF, organic farms; CF, conventional farms

INTRODUCTION

Although The Netherlands – with its relatively small area – is the fourth largest pig producer in Europe after Germany, Spain and France (Anon., 2002), it is remarkable that there have never been extensive surveys to investigate the presence of parasites in commercially kept pigs. The parasite fauna of wild boars in the Netherlands is much better known (Jansen, 1966). We were interested to see in our study whether species from wild boars have been transferred to outdoor-kept pigs, particularly on farms close to wild boar habitats. For a specific parasite such as *Isospora suis,* a study on 25 farms has been published (Eysker *et al.*, 1994). According to the figures of the insurance

company for slaughtered animals, more than 10% of the livers were condemned over the last 8 years, indicating a high prevalence of *Ascaris suum*, despite the availability of very effective anthelminthics (CBS, 2002).

The lack of knowledge of the pig parasite fauna contrasts with that in countries close to The Netherlands, where such studies have been carried out (Germany: Joachim and Daugschies, 2000; Belgium: De Deken *et al.*, 1982; France: Beloeil *et al.*, 2003; Denmark: Roepstorff and Jorsal, 1989; the Nordic countries: Roepstorff *et al.*, 1998). In Europe, most studies on many aspects of helminths in pigs, such as their epidemiology and the relation to management have been done in Denmark (Roepstorff and Jorsal, 1990; Roepstorff and Nansen, 1994; Nansen and Roepstorff, 1999; Roepstorff *et al.*, 1998; Carstensen *et al.*, 2002).

The aim of the present study was to find out which parasites occur on Dutch pig farms with different types of management (free-range, organic and conventional) and to look for differences between age groups (suckling pigs, weaners, fattening pigs and sows). Regular sampling over a year would allow the investigation of possible seasonal trends.

MATERIALS AND METHODS

Selection of the farms

Thirty-six farms participated in the study. Three types of farms were represented: free-range farms (FRF), organic farms (OF) and conventional farms (CF). The addresses of 16 FRF were derived from the official list of Dutch free-range pig farms available at the Animal Sciences Group-WUR at Lelystad. The addresses of 11 OF were given by Platform Biologica, the organization for organic farmers in The Netherlands. The addresses of nine CF with group housing on straw were received from Dumeco, the largest pig slaughter and trading organization in the Netherlands. An important criterion for participation in this study was the willingness of the farmers to cooperate. Big differences in management conditions existed between the farms, even within the same farm type. A common factor for all farms was that no anthelmintics were used during the study.

Selection of groups of pigs on the farms

Where possible, four age groups of pigs were sampled during the study: suckling piglets of $\sim$4 weeks of age, weaned pigs at the end of the weaning period (depending on the type of farm, varying from 5 to 7 weeks), fattening pigs within the last 2 months before delivery to the slaughterhouse and sows (mainly pregnant sows). It was not possible to sample all age groups on all farms, because some farms had only fattening pigs.

Farm visits and faecal samples

All farms were visited four times with a 3-month interval. It was agreed that the farmers would not treat with anthelmintics within the study period unless necessary. Ten faecal samples per age group were collected, taken either rectally, or from freshly deposited faeces. Transport of faeces to the laboratory took place in cooling boxes to prevent embryonation of the strongylid-type eggs. In the laboratory, a mixed sample per age group was prepared by taking the same weight of faeces (approximately 5 g) from each individual sample. A subsample was taken for faecal examination with a modified McMaster technique with a sensitivity of 50 eggs per gram of faeces (Borgsteede and Hendriks, 1973). After the subsample for the faecal examinations was taken, a small amount of faeces of this mixed sample was used to make a smear on an object glass for the detection of *Cryptosporidium* with the Ziehl-Neelsen technique (Henriksen and Pohlenz, 1981). The remaining faeces were used for a faecal culture (one week at 27°C) to identify the infective larvae from the strongyle-type eggs (Borgsteede and Hendriks, 1973).

Statistics

Statistical analysis was done with the χ^2-test. All results were carefully studied for possible seasonal trends.

RESULTS

Prevalence on farms

The results of the faecal examinations and cultures showed that an infection with parasites was present on most farms. Oocysts of coccidia and eggs of *A. suum*, *Oesophagostomum* spp. and *Trichuris suis* were the only parasite stages that were found. Cultures of faecal samples containing strongylid eggs showed that all identified L_3 larvae were *Oesophagostomum* spp. Thus all strongylid eggs were considered to belong to this genus. No infections with *Cryptosporidium* were detected.

Detailed information on the prevalence of parasite species according to farm type is presented in Table I. Statistical analysis demonstrated that free-range farms had a significantly lower prevalence of coccidial infections compared to organic farms and conventional farms ($p < 0.05$), while organic farms had a significantly higher prevalence compared to free-range farms and conventional farms. *Ascaris* infections were more prevalent on FRF and OF compared to CF ($p < 0.05$). No statistical difference between the farm types was found for *Oesophagostomum* and *Trichuris*.

TABLE I
Prevalence of coccidial infections (*Cocc*), *Ascaris suum* (*As*), *Oesophagostomum* spp. (*Oe*) and *Trichuris suis* (*Ts*) on free-range, organic and conventional pig farms in The Netherlands

Type of farm	No. of farms investigated	*Cocc* No. positive (%)	*As* No. positive (%)	*Oe* No. positive (%)	*Ts* No. positive (%)
Free-range	16	7 (43.8)[a]	8 (50)[b]	4 (25)	6 (37.5)
Organic	11	10 (90.9)[b]	8 (72.7)[b]	3 (27.2)	4 (36.4)
Conventional	9	6 (66.7)[a,b]	1 (11.1)[a]	2 (22.2)	1 (11.1)

[a,b]Different letters between means in the same column indicate a statistically significant difference ($p < 0.05$)

Prevalence in age groups of pigs

The four age groups of pigs were not represented on all farms. Accordingly, the number of age groups is lower than the number of farms in Table I.

The results of the faecal examinations according to the different age groups are presented in Table II.

Coccidia

Coccidial infections were present on all three farm types. The highest percentages of positive herds were found in the suckling piglets and the sows. On OF, the prevalence in fattening herds was significantly higher than on the FRF and CF ($p < 0.05$). In the sows, the prevalence on CF was lower than on FRF and OF ($p < 0.05$). Although species identification of the coccidia was not done systematically, the majority of the oocysts that were seen in the suckling piglets could be identified as *Isospora suis*, while in faecal samples of the sows almost exclusively *Eimeria* spp. were present.

Ascaris suum

Eggs of *A. suum* were significantly more prevalent in the fatteners of FRF and OF compared with those on CF ($p < 0.05$), but eggs were also seen in the faeces of animals of the other age groups. In the suckling piglets only two samples scored positive, each with only one egg in the counting chambers. The highest egg count during the study was 4250 epg in fatteners of a FRF.

TABLE II
Prevalence of coccidial infections (*Cocc*), *Ascaris suum* (*As*), *Oesophagostomum* spp. (*Oe*) and *Trichuris suis* (*Ts*) in suckling piglets, weaners, fatteners and sows on free-range, organic and conventional pig farms in The Netherlands

Pig group	Type of farm	No. of groups investigated	*Cocc* No. positive (%)	*As* No. positive (%)	*Oe* No. positive (%)	*Ts* No. positive (%)
Suckling piglets	Free-range	8	3 (37.5)	1 (12.5)	1 (12.5)	0
	Organic	10	7 (70)	1 (10)	1 (10)	0
	Conventional	9	5 (55.6)	0	1 (11.1)	0
Weaners	Free-range	8	4 (50)	1 (12.5)	1 (12.5)	2 (25)
	Organic	10	4 (40)	0	2 (20)	1 (10)
	Conventional	9	3 (33.3)	0	1 (11.1)	0
Fatteners	Free-range	14	1 (7.1)[a]	6 (42.9)[b]	2 (14.3)	2 (14.3)
	Organic	11	5 (45.5)[b]	6 (54.5)[b]	2 (18.2)	2 (18.2)
	Conventional	4	0[a]	0[a]	0	0
Sows	Free-range	8	7 (87.5)[b]	0	3 (37.5)	4 (50)
	Organic	10	8 (80)[b]	3 (30)	3 (30)	3 (30)
	Conventional	9	2 (22.2)[a]	1 (11.1)	2 (22.2)	1 (11.1)

[a,b]Different letters between means in the same column indicate a statistically significant difference ($p < 0.05$)

Oesophagostomum *spp.*

It was possible to culture larvae of this genus from faeces of all age groups. However, the results clearly demonstrate the highest prevalence in the sows on all three farm types. Egg counts were sometimes quite high: 3200 epg (sows on a CF!). No statistical differences could be demonstrated between the farm types.

Trichuris suis

This species was absent in the suckling piglets. There seems to be an increase in prevalence with age. Sows had the highest percentage positive samples, particularly on FRF and OF. The highest egg count in this study was 650 epg (sows on a FRF). As for *Oesophagostomum*, no differences in prevalence were found between farm types. However, if more farms had been sampled, it is likely that the trend of a higher prevalence on FRF and OF would show a significant difference with the CF.

Seasonal trends

The limited number of farms and of age groups within the farms allows us only to look for trends between the four sampling dates. There were no clear differences between the sampling dates. The number of positive farms within the three farm types was almost equal during the year. Farms that were positive for a certain parasite remained so during the whole study and the same was true for the age groups.

DISCUSSION

The results showed a high prevalence of gastrointestinal parasitic infections on pig farms in The Netherlands. In particular, helminth infections on free-range farms and organic farms were higher than on conventional farms. The prevalence of infections was high, but the number of different parasite species was rather limited. Only three helminth species were found. It is highly probable, based on unpublished studies, that most infections with *Oesophagostomum* spp. were *Oe. dentatum*. Larvae of *Hyostrongylus rubidus* were not seen in the faecal cultures. Also lungworms (*Metastrongylus* spp.), *Strongyloides ransomi*, spirurid nematodes (*Ascarops strongylina* and *Physocephalus sexalatus*) and hookworms (*Globocephalus urosubulatus*) were absent. Lungworms, spirurids and hookworms have a high prevalence in wild boars, but *H. rubidus* is absent in these animals (Jansen, 1966). Thus, cross-contamination of parasites from wild boars to outdoor reared pigs appeared to be absent in our study. Absence of *H. rubidus* in organic swine herds was also noted by Carstensen and colleagues (2002) in Denmark and on 13 pig fattening units with different management systems in Northern Germany (Joachim *et al.*, 2001).

Infections with coccidia were common in the suckling piglets on all three farm types. This confirms the results of Eysker and colleagues (1994) and Daugschies and colleagues (1999) on conventional farms. Eysker and colleagues (1994) found *I. suis* on 17 of 25 farms (68%). This is comparable with the OF in the present study (70%), but more than on the FRF (37.5%) and CF (55.6%). However, they examined piglets of 4–23 days of age, while the piglets in the present study were almost 4 weeks old. It is known that *I. suis* infections reach their peak around 2 weeks after birth. When the infection level is low, a longer patent period has been observed (Greve, 1985).

Eimeria spp. infections were common in the sows of the FRF (87.5%) and OR (80%), but were seen less often on CF (22.2%). According to Eysker and colleagues (1994), the species *E. spinosa, E. debliecki* and *E. suis* occur in The Netherlands. Neither in his study nor in ours were there reported clinical problems in sows that could be related to coccidial infections.

Ascaris suum was the most frequently found helminth, particularly in fatteners on the FRF and OF. The presence of eggs of *A. suum* in two samples from suckling piglets of less than 4 weeks of age was unexpected. Taking into account that the prepatent period of *A. suum* is longer and no intrauterine or transmammary infection route is known, the only explanation is a false-positive result due to the consumption of eggs. The fact that also sows on those farm were positive for *A. suum* agrees with this idea.

The phenomenon of false-positive *A. suum* egg counts has been extensively described by Boes and colleagues (1997), who stated that 4–36% of the faecal samples may be false-positive. They advise care with the interpretation of low *A. suum* egg counts in prevalence studies. Our results on the presence of *A. suum* eggs in fatteners on FRF and OF confirm the high condemnation figures that exist for these animals.

Infections with *Oesophagostomum* spp. were particularly seen in sows with access to pasture, i.e. on FRF and OR, although this worm genus was also found in indoor-kept sows on CF. On one of the OF, all age groups were positive at all sampling dates, so the infection must have been picked up indoors by the suckling piglets, because they did not have access to pasture. The farm used a deep-litter system with straw. Thus, larvae of *Oesophagostomum* spp. can develop during the whole year (temperature in the stable high enough) and/or infective larvae can stay alive for a long period. The development of infective larvae on pasture seems to be more risky, depending on the weather conditions (dryness) and presence of enough vegetation to give shadow, as shown by Roepstorff and Murrell (1997). If one looks at the prevalence in the four age groups, there seems to be an increase with age, indicating a lack of acquisition of immunity. This increase with age was also found by Carstensen and colleagues (2002).

No clinical signs that can be related to *Oesophagostomum* were observed in infected groups in our study.

Trichuris suis was, like *Oesophagostomum*, most frequent in the sows. *T. suis* was absent in the suckling piglets, which is logical if one takes the prepatent period into consideration. On CF, *T. suis* was found in only one sample on one farm. Under conventional husbandry management procedures *T. suis* seems less able to maintain itself than *A. suum* and *Oesophagostomum*. Carstensen and colleagues (2002) found *T. suis* in 6 of 9 organic herds. However, prevalences of *T. suis* within herds were low, viz. 2–9% in weaners and 10–19% in fatteners.

Seasonal trends could not be demonstrated. Based on the results of this study, there is a tendency that farms positive for a certain parasite remain so at the other sampling dates. This means that these particular parasites are well established on the farm. The same tendency was found within age groups. This can be illustrated for all three helminth species. When fatteners on a farm were positive for *A. suum*, the next group of fatteners at the next sampling date had good chances of being positive as well. For *Oesophagostomum* and *T. suis*, this feature was also observed in the sows, although it cannot be excluded that within this group the same animals were sampled on different dates. The fact that there is no clear seasonal trend for the helminth species might indicate that pasture plays a minor role in the epidemiology of these three species and that the life cycles can easily be completed indoors.

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