Relationship between the prevalence of gastrointestinal nematode infections and management practises in pig herds in Thika District, Kenya

J M Kagira, P W N Kanyari*, W K Munyua* and R M Waruiru*

Kenya Agricultural Research Institute – Trypanosomiasis Research Centre (KARI-TRC),
PO Box 362, Kikuyu, Kenya
***Department of Veterinary Pathology, Microbiology and Parasitology, University of Nairobi,**
PO Box 29053, Nairobi, Kenya
jkagira@yahoo.com

Abstract

Thirty five (35) commercial pig herds in Thika District, Kenya were surveyed to determine the relationship between nematode parasitism and management practices. In each herd, faecal samples were collected from 25 pigs in all the age groups and examined for the presence of nematode eggs. Management factors of the herds were recorded by a questionnaire administered during visits and its association with the occurrence of nematode species examined using the chi-square analysis.

High prevalence of the nematode was significantly ($p<0.05$) related to irregular worm control program, dung removal and disinfection. Other significant ($p<0.05$) factors were presence of non-concrete floors, lack of bedding, late weaning, small herds sizes and provision of low quality non-commercial feeds. These associations were most significant for the *Oesophagostomum* spp. The highest prevalences of *Oesophagostomum* spp/*Trichuris suis*, *Ascaris suum* and *Strongyloides ransomi* were recorded in farms using piperazine, levamisole and fenbendazole, respectively. The epidemiology of the gastrointestinal nematodes is discussed in relationship with the various management practices in different pig herds.

Key words: epidemiology, husbandry, pig parasites

Introduction

Swine production systems are currently characterised by a high diversity with regard to management type and production intensity (Roepstorff and Nansen 1994). This implies that the helminth spectrum and intensity of infection vary greatly, especially in countries where there are several types of production systems. Pigs in Kenya are produced under a variety of production systems ranging from intensive commercial pig farms in Central Kenya to free range traditional

system in western Kenya (Wabacha 2004). The smallholder system intensive system in Central province contributes significantly to pig industry in Kenya and the growth of pig industry in these areas is influenced by improved markets (Kagira 2001, Wabacha 2004). The main type of breeds reared by these farmers are pure and cross-breeds of Land race and Large white pigs.

Worldwide, a number of studies have been undertaken to determine the relationship between the prevalence of helminth infections and management practises present in pig farms. Such studies have been done in UK (Pattison et al 1980a), USA (Morris et al 1984), Australia (Mercy et al 1989) and Denmark (Dangolla 1994) amongst other countries. These studies have shown that poor sanitation, management system, climate, and sub-optimal feeding of pigs may influence the occurrence and pattern of infection. In contrast, there is no published information on the relationship between the nematode infections and management factors in piggeries in Kenya.

Therefore, a questionnaire and parasitological survey was carried out in commercial pig herds in Thika District, Central Kenya, in order to obtain information on the relationship between the current methods used to control parasites in the farms and prevalence of different gastrointestinal (GIT) nematodes in the pig herds. In Kenya, Thika District produced 23% of the pigs, taking the lead countrywide (Anon 1998).

Materials and methods

Location

The study was conducted in 35 commercial pig herds in Thika district which is located in the Southern part of Central Province of Kenya and lies between latitude 1.45^{o}S - 3.53^{o}S and longitude 36.35^{o}N - 37.25^{o}N.

Farms and questionnaire

The farms used in the study belonged to farmers who supplied animals to a leading pork processing company in Kenya (Farmers Choice Company), which processes 70-80% of the pigs produced in Kenya. During the selection process, every farm with over 30 pigs was included in the survey.

During each visit to the farms, the following information was sought: herd size, system of production, frequency of dung removal and disinfection, floor type, provision of bedding, anthelmintic administration regime, weaning age and type of feed provided to the pigs.

Parasitological analysis

Faecal samples were collected per rectum from five pigs in each of the following five classes of pigs per farm: piglets (0-8 weeks), weaners (9-10 weeks), porkers (11-16 weeks), baconers (17-28 weeks) and adults (over 28 weeks). The samples were sent to the laboratory and analysed to determine the eggs per gram (EPG) using a modified McMaster method with a sensitivity of 100 EPG of faeces (MAFF 1986). Larval cultures for samples containing strongyle eggs were set up to differentiated *Oesophagostomum* spp and *Hyostrongylus rubidus* (MAFF 1986).

Statistical analysis

Descriptive statistics were calculated using the statistical software package Statview®. Chi-square (c^2) analysis was used to test for the associations between the GIT nematode prevalence among herds and management practices.

Results

The results of univariate analysis of husbandry factors with herds being positive for nematode infections are described below. A farm with at least one pig shedding nematode eggs was indicated as infected. Although the results of this analysis may be subject to confounding by inter-correlations of variables, several important associations were identified. In Tables 1, 2 and 3, the relationship between prevalence rates and management factors is shown.

Effect of anthelmintic used

Ninety seven percent of the farmers were using anthelmintics, although nematode infections were observed in 94% of the farms. Piperazine was the most commonly used anthelmintic, with 71.4% of the farmers using this drug in 1999 (Table 1).

Table 1. Relationship between prevalence of GIT nematode infections and anthelmintics used and deworming program in pig herds in Thika District, Kenya

Variable	Number of herds	Prevalence of worm infection				
		Any Species	*Oesophagostomum* spp	*Ascaris suum*	*Trichuris suis*	*Strongyloides ransomi*
Anthelmintics						
Ivermectin	3	1.7	0	0	1.67	0
Fenbendazole	4	14	0	4	4	6
Levamisole	10	32.6	20.8	11.7	4.3	0
Piperazine	25	50.2	38.7	8.95	8.4	3.6
Deworming program						
Regular	23	23.8	15.5	4.9	2.96	1.2
Irregular	12	67	52.8	14	12.7	4.2
c^2		147	128.5	20.8	29.3	7.2
p value		0	0	0	0	0.007

Key: 0= p<0.00001

The level of infection was highest in herds using piperazine (50.2%), followed by levamisole (14%), and ivermectin (1.7%). The prevalence of *Oesophagostomum* spp. and *Ascaris suum* was significantly lower ($p<0.05$) in pigs treated with ivermectin than those treated with any other drug.

The prevalence of *Oesophagostomum* spp. was highest in farms using piperazine (38.7%), followed by those using levamisole (20.8%). This was statistically significant ($p<0.05$). No animals were infected with *Oesophagostomum* spp. in any of the farms where avermectins or fenbendazole (Panacur^R) were used. For *Ascaris suum*, the highest prevalence was in farms using levamisole

(11.7%), followed by piperazine (8.95%) and fenbendazole (4%). As such, the prevalence of infection in herds using fenbendazole was significantly lower ($p<0.05$) than in farms using either levamisole or piperazine.

For *Trichuris suis*, the highest prevalence was registered in farms using piperazine (8.4%), followed by those using levamisole (4.3%), fenbendazole (4%), and ivermectin (1.67%). This shows that farms using either ivermectin, fenbendazole, or levamisole had significantly lower prevalence ($p<0.05$) of this worm compared to those using piperazine.

Strongyloides ransomi infection was recorded in farms using fenbendazole (6%), and piperazine (3.6%). The difference between the prevalences was significant ($p<0.05$). However, farms using levamisole and ivermectin did not have any infection with this worm.

Effect of worm control program

The worm control data revealed that 48% of the farmers regularly treated their animals (Table 1) and the anthelmintic deworming program used was significantly associated with prevalence of all nematodes in pigs ($p<0.05$). The prevalence of infection by at least one nematode was lower in herds that had regular treatments as opposed to those with irregular treatments ($p<0.05$). This association held true for the four nematode infections i.e., *Oesophagostomum* spp., *Ascaris suum, Trichuris suis* and *Strongyloides ransomi*.

Effect of dung removal

From the study, 51.4% of the farms removed the dung from the pens on daily -basis as opposed to 48.5% who did it after every two or more days (Table 2).

Table 2. Relationship between prevalence of GIT nematode infections and hygiene, floor type and provision of beddings in pig herds in Thika District, Kenya

Variable	Number of herds	Prevalence of worm infection				
		Any species	***Oesophagostomum* spp**	***Ascaris suum***	***Trichuris suis***	***Strongyloides ransomi***
Dung removal						
Daily	18	17.7	10.1	1.3	3.5	1.6
Less frequent	17	60.8	47.5	15.7	9.4	3.1
c^2		162.5	144.3	56	11.7	2.15
p value		0	0	0	0	0.14
Washing						
Regular	22	27.2	19.2	7.1	4.5	0.2
Irregular	13	61.2	47.3	11.3	9.5	5.3
c^2		94.1	65.9	3.6	7.7	15
p value		0	0	0.058	0.01	0
Floor type						
Concrete	22	33.7	22.6	8	6	1.8

Not concrete	13	47.7	38.1	8.9	6.8	3.1
c^2		16.3	23.1	0.2	0.2	0.9
p value		0	0	0.7	0.7	0.3
Bedding						
Provided	20	29.2	19.2	7.6	6.6	2
Not provided	15	51.2	40.5	9.3	5.9	2.7
c^2		41.5	45.9	0.8	0.2	0.7
p value		0	0	0	0.07	0.41

Key: 0= p<0.00001

The overall prevalence of infection was significantly lower ($p<0.05$) in farms where dung was removed daily. This was true for infections with *Oesophagostomum* spp., *Ascaris suum* and *Trichuris suis*.

Effect of disinfection of pens

Sixty three percent of the farmers cleaned and disinfected their pens daily as compared to 37.1% who cleaned after every two or more days (Table 2). The overall prevalence of infection was significantly higher ($p<0.05$) in farms where there was less frequent disinfection. This observation applied to infections of *Oesophagostomum* spp., *Trichuris suis* and *Strongyloides ransomi*.

Effect of the type of floor

More farmers (62.9%) kept their animals on pens made of concrete floors, as compared to 37.1% who kept the animals on floors characterised by broken down concrete, stones, straw, saw dust etc. (Table 2). The prevalence of infection with *Oesophagostomum* spp. was significantly lower ($p<0.05$) in farms having concrete floors.

Effect of provision of bedding

The proportion of the farmers who provided bedding to their sows and piglets were 57.1% compared to 42.9% who never provided (Table 2). Saw dust and wood shavings were the main type of bedding provided. The overall prevalence of *Oesophagostomum* spp. infection was significantly higher ($p<0.05$) in farms where bedding was not provided.

Effect of weaning age

Twenty eight (80%) farmers weaned their piglets at an age of 2 months and below, while only 7 (20%) weaned piglets at over two months of age (Table 3).

Table 3. Relationship of prevalence of GIT nematode infections and system of production, herd size, weaning age and type of feeds in pig herds in Thika District, Kenya

Variable	**Number of herds**	**Prevalence of worm infection**				
		Any species	***Oesophagostomum* spp**	***Ascaris suum***	***Trichuris suis***	***Strongyloides ransomi***
Production						

system						
Breeding and fattening	34	29.4	29.2	8.6	6.3	2.4
Fattening	1	0	0	0	5	0
c^2		5.7	8.1	1.9	0.1	0.6
p value		0.02	0.004	0.17	0.81	0.44
Herd size						
60 or more pigs	16	33.3	25.4	3.6	1.2	1.3
59 or less pigs	19	43.1	30.8	12.3	6.2	3.2
c^2		8.5	3.1	20.7	13.1	3.3
p value		0.004	0.08	0	0.0003	0.068
Weaning age						
2 months or less	28	35.7	25.6	7.4	5.9	2
Above 2 months	7	50.4	39.4	12	8	3.43
c^2		13.5	12.7	3.3	1.2	1.5
p value		0.0002	0.001	0.43	0.27	0.23
Types of feeds						
Commercial	24	33.6	25.6	6.2	5.9	2.2
Non-commercial	11	49.6	40.8	13	7.1	2.6
c^2		19.6	30.2	11.3	0.3	0.3
p value	0	0	0	0	0.6	0.6

Key: 0= p<0.00001

The prevalence of infection was higher in farms where animals were weaned at an age above two months ($p<0.05$). This observation was true for the *Oesophagostomum* spp. infection whereas with *Ascaris suum, Trichuris suis* and *Strongyloides ransomi*, the difference in the prevalence between the two categories of farm management was not significant.

Effect of herd size

There were 19 (54.3%) farms with a herd of less than 59 animals, as opposed to 16 (45.7%) farms having a herd of more than 60 animals (Table 3). The prevalence of infection with *Ascaris suum* and *Trichuris suis* was significantly higher ($p<0.05$) in farms having small herds. It was not significant in farms infected with either *Oesophagostomum* spp. or *Strongyloides ransomi* ($p>0.05$).

Effect of production system

A total of 34 (97.1%) farms had a breeding and fattening type of production, while only one farm had the fattening type of production (Table 3). The overall prevalence of infection in farms where

there was a breeding and fattening type of production was significantly higher ($p<0.05$). This observation only applied to *Oesophagostomum* spp.

Effect of the type of feeds

More farmers (68.6%) gave their animals high quality commercial feed, as compared to 31.4% who gave non-commercial feed (Table 3). The prevalence of infection by *Oesophagostomum* spp. and *Trichuris suis* infections was significantly higher ($p<0.05$) in farms which gave the non-commercial feeds.

Discussion

It is clear from the data gathered that considerable effort is being made by pig owners in Thika District, Kenya to control the GIT nematode parasites. The results were based on a univariate analysis of farm level factors. Similar univariate relationships have been presented previously (Pattison et al 1980b; Morris et al 1984; Mercy et al 1989). The type of anthelmintics and anthelmintic deworming program used was found to be strongly associated with the prevalence of nematode infection. This observation was true for all the identified GIT nematode parasites during the study, and is consistent with the findings of other workers (Mercy et al 1989; Roepstorff and Jorsal 1990; Dangolla 1994). Anthelmintics were used by 97% of the farmers, while nematode infections were observed in 94% of the farms, showing that most of the farm had patent infection. In France, 97% of the farms were also found to be using anthelmintics to control helminth parasites (Beloeil et al 2003). The association of the different types of drugs administered and the prevalence of different nematode infection varied. For example, *Oesophagostomum* spp. was most prevalent in those farms where piperazine and levamisole was used, while in farms using avermectins and fenbendazole no infection with this nematode was reported. The possibility of use of substandard drug and under-dosing in Kenya (Monteiro et al 1998, Kagira 2001) could explain the high prevalence of *Oesophagostomum* spp. in farms where piperazine was used.

The prevalence of *Trichuris suis* was higher in pigs from farms using piperazine and lowest in those using ivermectin. The drug piperazine has been found to be ineffective against *Trichuris suis* (Prichard 1978) and the only drugs, which have high efficacy against this parasite, are the benzimidazoles and avermectins (Marriner and Armour 1986). Although levamisole and piperazine have been shown to have good activity against *Ascaris suum* (Marriner and Armour 1986), in the present study, a higher prevalence of this worm was reported in farms using these drugs. This may be due to: mode of administration (most farmers used the drench and powder form, this may can cause underdosing as suggested by Mercy et al (1989), presence of substandard drugs in the market (Monteiro et al 1998, Kagira 2001) and the possibility of the occurrence of anthelmintic resistance (Conder and Campbell 1995, Kagira et al 2003). The prevalence of infection by *Strongyloides ransomi* was highest in the farms using fenbendazole and piperazine, while the farms, using either levamisole or ivermectin did not have any infection with this nematode. Benzimidazole and piperazine drugs are not effective against *Strongyloides ransomi*, while levamisole and ivermectin are quite effective (Marriner and Armour 1986).

Overall, the best drug in controlling pig parasites was found to be the avermectins (doramectin and ivermectin). Most of the drugs in this category are known to have a high therapeutic index, not only because of extraordinary safety in mammals (in absolute terms), but because of extraordinary potency against most internal and external parasites of domestic animals (Stewart et al 1981, Conder and Campbell 1995, Borgsteede et al 2007). The fact that the avermectin drugs in the market are very costly and can only be administered subcutaneously could explain the low usage of the drug in the studied farms. On the other hand, the over-reliance on reliance of anthelmintics drugs to control GIT nematodes in pigs and other livestock has been termed as inappropriate and ultimately unsustainable (Krecek and Waller 2006). This is chiefly because of the emergence of anthelmintics resistance and high cost of these drugs amongst the resource poor communities (Krecek et al 2006, Kagira et al 2003). Farmers must be encouraged to adopt integrated parasite control schemes where chemotherapy plays a much less dominant role.

There was a significant negative association between the frequency of dung removal, disinfection of the pens and the prevalence of nematode infection in pigs in the current study. This observation was true for *Oesophagostomum* spp., *Ascaris suum* and *Trichuris suis* and was consistent with the findings of Dangolla (1994) and Mercy et al (1989). Regular removal of dung and disinfection of the floors reduces access of the coprophagous pigs to the faeces, which are the major reservoir of free-living infective parasites and reduces within the herd transmission of helminth infections (Roepstorff 1991). Animals raised in concrete floors had significantly lower levels of infection with at least one nematode, as compared to animals raised in other types of floors. This was true for the *Oesophagostomum* spp., while in the other three genera the differences in the two types of floors was not significant. Most farmers with concrete floors in their farms were able to remove the dung and disinfect regularly due to the convenience thus reducing infective free-living nematodes. Other authors (Pattison et al 1980b, Roepstorff and Jorsal 1990, Dangolla 1994) reported higher prevalence of *Ascaris suum* in pigs raised in concrete floors as compared to those on slatted floors. The survival and availability of the infective parasites in the floors compared in various studies are different and as such, the level of infection varied.

The observed higher infection of *Oesophagostomum* spp. and *Ascaris suum* in pig farms where bedding was not provided was different from Dangolla's (1994) report in Denmark where it was found that provision of bedding led to increased infection of sows. The difference in the two reports could be due to the varying amount of bedding provided to pigs in the two studies. When a lot of bedding was provided, and not removed frequently, nematodes survived longer because of protection from adverse climatic factors leading to possibility of spread of infection to non-infected animals in the same herd (Roepstorff and Jorsal 1990). The higher prevalence of infection in farms with late weaning was only statistically significant for the *Oesophagostomum* spp. as was previously reported by Pattison et al (1980b), Roepstorff and Jorsal (1990) and Dangolla (1994). These authors have postulated that reasons for this observation are presence of more intensive management and diminished transmission in the farrowing pens in herd with early weaning age. Sows are a major reservoir of the nematode infections and as such the longer the sows stay with the piglets the higher the exposure of the immunologically naive piglet to the infections (Dangolla 1994, Joachim et al 2001).

There was an association between herd size and prevalence of the nematode infections where farms with small herds had higher levels of infection. A positive correlation between herd size and

infection level of *Ascaris suum* and *Oesophagostomum* spp. has been reported by other workers (Pattison et al 1980b, Morris et al 1984, Roepstorff and Jorsal 1990). Most farmers with large farms are economically well-off and as such are relatively able to control parasites. Farmers with smaller farms are most likely to buy cheap, substandard drugs which may not even be effective against the parasite in the farm.

Pigs fed on commercial feed recorded a significantly lower prevalence of *Oesophagostomum* spp. and *Ascaris suum* infections. The influence of diet on parasite infestation has been shown in pigs by Bjorn and colleagues (1996), where pigs fed on ground barley plus protein had higher egg counts of *Oesophagostomum* spp. and *Ascaris suum* compared to pigs fed on commercial pelleted feed. It has been shown that the host gives priority to the reversal of the pathophysiological consequences of parasitism over other body functions and it is expected that improved nutrition will always lead to improved resilience. The non-commercial feed given by other farms in the present study, included the use of left overs from the markets, hotels, schools etc. and fodder grown in the farm. Such diets especially cabbages, maize stalks and nappier grass, have a high level of dietary fibre notably non-starch polysaccharides (NSPs), which favour the establishment of *Ascaris suum* and *Oesophagostomum* spp. (Petkevicius et al 1997).

Conclusions

- In conclusion, this study has shown that the prevalence of GIT nematodes in the intensive pig herds was significantly associated with type of anthelmintics used, worm control program, level of sanitation, type of floor, provision of bedding, time of weaning, herds sizes and type of feed provided.

- To ameliorate the losses which could be associated with nematode infections, the pig farmers and extension agents in the District should be made aware of effective nematode control strategies including improvements in management practices.

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