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Short communication

Smallholder pig production: Prevalence and risk factors of ectoparasites

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ABSTRACT

A cross-sectional study was carried out in the Mbeya Region, Tanzania, with the aim of describing the distribution and diversity of ectoparasites on pigs, within confinement and free-range production systems of smallholder farms. A total of 128 farms were surveyed, with 96 practising confinement and 32 practising free-range production systems. The prevalence of ectoparasites on pigs within confinement and free-range production systems was 24% and 84%, respectively. Logistic regression analyses revealed that keeping pigs in a free-range system and the presence of neighbouring pigs were risk factors for ectoparasites. Within the confinement system, contact with neighbouring pigs and the time interval (in months) since last ectoparasitic treatment were additionally identified as risk factors. The prevalence of *Haematopinus suis* was 20% in confined pigs and 63% among free-range pigs. Free-ranging of pigs and presence of neighbouring pigs were also identified as risk factors for the presence of lice. Three species of fleas were identified; *Tunga penetrans*, *Echidnophaga gallinacea* and *Ctenocephalides canis*. The prevalence of fleas was 5% and 13% within confined and free-range, respectively. Two pigs (2%) were found infested with *Sarcoptes scabiei* var. *suis*. Ticks found belonged to four genera; *Amblyomma* spp., *Rhipicephalus* spp., *Haemaphysalis* spp., and *Boophilus* spp. The prevalence of hard ticks among the free-range pigs was 50%. Ectoparasites were more prevalent in the free-range system although highly prevalent within both production systems. Keeping pigs in a free-range system and contact with neighbouring pigs were main risk factors for the presence of ectoparasites. Confinement was highly effective as a preventive tool against hard ticks.

1. Introduction

Pig production in sub-Saharan Africa has been hampered by diseases such as African swine fever (ASF) and cysticercosis (Penrith, 2009; Phiri et al., 2003). However, a recent study of smallholder farmers from Kenya mentioned certain diseases as the most important constraint for sub-Saharan pig production, with ectoparasites being the most important based on clinical descriptions (Kagira et al., 2010). The aim of the present study was therefore to determine the distribution and diversity of ectoparasites, and identify risk factors for the presence of these on pigs, within confined and free-range production systems of smallholder farms.

2. Materials and methods

2.1. Study area

The study was carried out in Mbeya Region, Tanzania, in Mbeya Rural and Mbozi districts located between latitudes

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Table 1
Prevalence [95% confidence interval] of ectoparasites, *Haematopinus suis*, *Sarcoptes scabiei* var. *suis*, hard ticks and fleas from both confinement and free-range production systems in Mbeya Region, Tanzania.

Parasite	Prevalence (%)		
	Confinement system (Mbeya Rural) ($n = 96$)	Free-range system (Mbozi) ($n = 32$)	Both systems ($n = 128$)
Ectoparasites[a]	24 [15–33]	84 [71–97]	39 [30–48]
H. suis	20 [12–28]	63 [45–78]	30 [22–39]
Hard ticks	1 [0–3][b]	50 [32–68]	13 [7–19]
Fleas	5 [1–10]	13 [7–24]	7 [3–12]
S. scabiei	2 [0–5][b]	0	2 [0–4][b]

Sample size = *n*.
[a] Ectoparasites (*H. suis*, *S. scabiei* var. *suis*, hard ticks and fleas).
[b] Zero not included in the 95% confidence interval because observations were made.

8°14′ and 9°24′S, and longitudes 32°04′ and 33°49′E. Mbeya Region has a subtropical climate with bimodal rainfall from approximately October to December and March to May. Both districts are rural areas with pig production almost exclusively on a smallholder level.

2.2. Study design and sample size

A cross-sectional study was carried out in the dry season from May to August 2011 after an outbreak of African swine fever, during which farmers reported having lost or slaughtered most of their pigs. In total, 128 pigs were sampled, 96 from smallholder farmers practising confinement located in 24 villages in Mbeya Rural district and 32 from farmers practising free-range in 7 villages in Mbozi district. Four farmers from each of the 24 villages in Mbeya Rural district were identified using the 'snowball' method (Sikasunge et al., 2007). All farmers practising free-range within the 7 villages of Mbozi district were included in the study. One pig was randomly selected from each farm if farmers were keeping more than one pig.

2.3. Data collection

Structured questionnaire interviews of key farm informants were carried out to explore farm variables such as level of confinement, ectoparasitic treatment history, perception on current disease status, disease history, and pig husbandry practices. Interviews were conducted by the same interviewer in Swahili or translated to local tribal language when necessary. The presence or contact with neighbouring pigs was not investigated by observation, but relied on the farmers' statements given in the questionnaire.

Pigs were manually restrained using a pig snare and thorough full body visual inspection performed. Ectoparasites were counted and specimens were collected for further identification. Skin scrapings for mite detection were performed, with a scraping spoon, inside the pinna of both ears, until traces of blood could be seen.

2.4. Parasitological examination

Collected ectoparasites were microscopically examined (40×) and identified to nearest possible taxa according to listed keys (Okello-Onen et al., 1999; Sonenshine, 1993). Skin scrapings were examined for *S. scabiei* var. *suis* with a modified floatation fluid (saturated NaCl added 25% glucose, 1.225ρ) as previously described by Kambarage et al. (1990).

2.5. Statistical analyses

Data were analysed using STATA® (Statistical software: version 11; Stata Corporation, College Station, USA). Prevalence data were analysed using either Fisher's exact test or the χ^2-test. Logistic regression models were used to compute odds ratios (OR) to identify risk factors for the presence of ectoparasites or *H. suis* as dichotomous dependent variables. Logistic regression models were also used to explore the risk factors for the presence of ectoparasites or lice on pigs within the confinement production system only.

3. Results

The overall prevalence of ectoparasites within both production systems was 39% [30–48] and consisted of lice, hard ticks, fleas, and mites (Table 1). The prevalence of ectoparasites within the confinement production system and the free-range production system was 24% [15–33] and 84% [71–91], respectively, with a significant difference between the two ($p < 0.001$, χ^2-test). The logistic regression model for the presence of ectoparasites in regards to the two types of production systems identified free-range ($p < 0.001$, OR = 17.9 [4.0–76.1]) and the presence of neighbouring pigs ($p = 0.018$, OR = 4.33 [1.29–14.57]) as risk factors. Contact with neighbouring pigs ($p = 0.031$, OR = 4.15 [1.14–15.1]) and the time interval (in months) since last ectoparasitic treatment ($p = 0.030$, OR = 1.17 [1.02–1.35]) were identified as risk factors within the confinement system.

The prevalence of lice was 20% [12–28] within the confinement production system and 63% [45–78] in the free-range system, with an overall prevalence of 30% [22–39] among the two systems (Table 1). Free-ranging of pigs ($p = 0.003$, OR = 7.7 [2.0–30.0]) and the presence of neighbouring pigs ($p = 0.002$, OR = 8.1 [2.2–30.6]) were found as risk factors. Within the confinement production system contact with neighbouring pigs was identified as a risk factor for the presence of lice (OR = 4.68 [1.17–18.68]).

The prevalence of hard ticks among free-range pigs was 50% (Table 1). All hard ticks were found on the abdomen,

between the legs, or around the neck and ears. The hard tick burden was 1–13 with a mean of five ticks per infested pig ($n = 17$). Hard ticks found belonged to four genera; *Amblyomma* spp., *Rhipicephalus* spp., *Haemaphysalis* spp., and *Boophilus* spp. No hard ticks were found within the confinement system.

The prevalence of fleas within the confinement production system and the free-range production system was 5% and 13%, respectively (Table 1). There was no significant difference ($p = 0.226$, Fisher's exact test) between the two systems when analysed as a dichotomous dependent variable. Three species of fleas were identified as *T. penetrans*, *E. gallinacea*, and *C. canis*.

S. scabiei var. *suis* were detected in the ear scrapings of two pigs from the same village among the confined pigs in Mbeya Rural district yielding a prevalence of 2% (Table 1). Both pigs had been treated 2 months prior, one with a subcutaneous injection of ivermectin (1%), the other with an acaricidal spray (amitraz 12.5%). The majority of farmers (70%) had treated their pigs, commonly with injectable ivermectin, within the last ten months of the study. No *S. scabiei* var. *suis* were recovered from free-ranged pigs.

4. Discussion

The predominate ectoparasites were lice, hard ticks, and fleas, while *S. scabiei* var. *suis* was only found on two farms within the confinement production system. Hard ticks were found to be highly prevalent on free-range pigs, but completely absent on pigs from confinement systems. Presence of neighbouring pigs and free-ranging of pigs were identified as risk factors for the presence of ectoparasites and lice. Under the confinement system the time interval since last ectoparasitic treatment was identified as a risk factor for ectoparasites, and contact with neighbouring pigs was identified as a risk factor for both ectoparasites and lice.

The prevalence of ectoparasites and lice was significantly different between production systems although highly prevalent in both. The prevalence of ectoparasites and lice among the free-range pigs was similar to a previous report of free-range pigs in Ghana (Permin et al., 1999). In regards to the confined pigs, no relevant comparison with previous studies was possible in terms of prevalence, since no prevalence data exist on the smallholder level for confined pigs. Keeping pigs in a free-range system and the presence of neighbours keeping pigs were identified as risk factors for the presence of ectoparasites and lice. For the confinement production system only, contact with neighbouring pigs was identified as a risk factor. This is supported by pigs' gregarious nature and the transmission characteristics of the majority of ectoparasites which are contact dependent, and in concordance with the difference in prevalence between the two production systems and free-range as a risk factor. The association of contact with neighbouring pigs and the presence of lice, support the general understanding that no vectors exist to transmit lice. In comparison, studies from modern production systems have shown pasturing of pigs as a risk factor for lice (Damriyasa et al., 2004; Wooten-Saadi et al., 1987). This could relate to free-range in terms of possible contact with other pigs, domestic or feral. In terms of the confined pigs, the time interval (in months) since last ectoparasitic treatment was additionally identified as a risk factor for ectoparasites only. When comparing results on ectoparasites, based on the time interval of last ectoparasitic treatment variable, it indicates that parasitic treatments are more effective within the confinement system compared to the free-range system. In regards to lice, the time interval (in months) since last ectoparasitic treatment could not be associated as a risk. However, this may be explained by the fact that all farmers who treated their pigs, did so once a year. Since pharmaceuticals products such as ivermectin, which were commonly used in the current study area, are ineffective against lice eggs, treatment is inefficient at breaking the life cycle of lice when administrated only once (Scott and McKellar, 1992).

This study showed that confinement is highly effective as a preventive tool against hard ticks. Although, the two production systems were located in different areas, it is unlikely that hard ticks were absent from the environment in Mbeya Rural district based on the biology and habitat preference of hard ticks (Anderson and Magnarelli, 2008). The burden of hard ticks among the free-ranged pigs in Mbozi district was relatively low. Because of the short duration (1–2 weeks) a hard tick parasitizes its host, and the possible seasonal variations in the distribution, large variations in prevalence and parasite burden might be present throughout the year. Three out of the four genera of hard ticks found in the current study have been reported on free-ranged pigs in Ghana (Permin et al., 1999).

Fleas were quantitatively estimated on each individual pig. However, because of fleas' mobility and tendency to leave the host when disturbed, the data on the presence of fleas were analysed binomially to increase the validity. Therefore, the prevalence reported in this study is suspected to be an underestimation of the true prevalence. There was no difference between the two production systems which can also be subscribed to fleas' mobility, although pigs were confined in one system, they were outside with relative short distance to other free-roaming animals and suitable environment for flea larvae development.

Although only two pigs were found positive for *S. scabiei* var. *suis* by skin scraping, the low sensitivity of the diagnostic test must be considered as an important limitation. Skin scraping is the only diagnostic test available with 100% specificity for *S. scabiei*, but the sensitivity is low (Gutierrez et al., 1996; Hollanders et al., 1995; Kambarage, 1991). The absence of *S. scabiei* var. *suis* within the free-range system is in contrast to a study from Ghana where *S. scabiei* var. *suis* was found highly prevalent based on clinical signs and mite recovery (Permin et al., 1999). The low prevalence of *S. scabiei* var. *suis* could be explained by the use of ivermectin. The majority of farmers had treated their pigs within the last ten months. Treatment, especially subcutaneous injection of ivermectin, also as a single injection, has proved to be very effective, against sarcoptic mites (Ohba et al., 1989). The low prevalence of *S. scabiei* var. *suis* found was in concordance with the farmers' own reports of current Sarcoptic mange problems.

Differences observed in this study could be ascribed from sample size disparity or discrepancies between the two districts. It was not possible to compare the free-range

and confinement production systems within the same district, because farmers primarily adhere to local district laws on confinement.

In conclusion, ectoparasites were highly prevalent within both production systems, although more in the free-range production system. Keeping pigs in confinement production systems is an effective preventive tool against hard ticks and lowers the risk of ectoparasitic infestations even at the smallholder level. Farmers should be encouraged to practise confinement, thereby minimising the risk of ectoparasitic infestations.

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