



## Research

## Is *Sarcoptes scabiei* infection in pigs a major welfare concern? A quantitative assessment of its effect in the host's nocturnal rubbing and lying behavior



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## ABSTRACT

The nocturnal rubbing and lying behavior of commercial fattening pigs from moderately (M) and heavily (H) *Sarcoptes scabiei*-infected farms was investigated. The study included 4 cohorts (2 per farm) of 11–15 acaricide-treated (uninfected) and untreated (infected) 4- to 7-month-old pigs, and the time and number of behavioral bouts were monitored for 350 hours over 101 days. Auricular mites, dermatitis, and plasma histamine concentration were investigated postmortem at the age of 7 months, and histamine concentration was also analyzed at the age of 3 months in 3 cohorts. The percentage of pigs with mites was 27% and 79% in untreated farm M and H cohorts and 0% in treated pigs. Erythematous hypersensitive dermatitis was observed in both treated and untreated animals; however, histamine levels were much greater in untreated compared with treated pigs and increased with time in the former group. Rubbing was significantly increased in untreated compared with treated pigs, but it was generally low and with small variations over time. The mean rubbing time per 210 minutes (1 day sample) was 0.00–0.79 and 0.00–0.65 minutes in untreated pigs in farms M and H, respectively, and 0.00–0.15 and 0.00–0.03 minutes in treated pigs in farms M and H, respectively. The mean lying time and number of events of standing up were similar for treated and untreated pigs, and differences between farm cohorts were not associated to *S. scabiei* infection. Moreover, the average pig's lifelong weight gain also appeared to be independent of infection. The small effect of *S. scabiei* on pig behavior and growth contrasts with the much greater effect that the nonburrowing mite *Psoroptes ovis* has been reported to have in a comparable study in sheep (Berriatua et al., 2001). The reasons for this outcome are unclear and could be related to differences between studies in the time when behavior was monitored in relation to initial infection, with pigs investigated at a later stage compared to sheep. Study results question the parasite's effect on pig welfare and have important implications in swine management. Moreover, differences in histamine levels in treated and untreated pigs could be diagnostically useful to detect infected herds.

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## Introduction

Swine mange caused by *Sarcoptes scabiei* var *suis* remains a widespread infection worldwide, decades after the discovery of the macrocyclic lactones as highly effective acaricidal compounds (Lee

et al., 1980). Macrocyclic drugs are presently available as generic pharmaceuticals, and good and simple protocols are available for eradicating the parasite from infected farms (Rueda-López, 2006). The effect of *S. scabiei* on health is a major driving force for controlling infections, and numerous studies have investigated the effect of infection on production parameters with variable results (Davies, 1995). Assessing the effects of infections in animal welfare also provides valuable economic information and allows incorporating ethical judgment in disease control decisions (McInerney, 1996; Nicol, 2011).

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In the course of infection within the host's epidermis, *S. scabiei* induces strong type I hypersensitive reactions resulting in the liberation of histamine, causing pruritus and erythematous papular dermatitis (Sheahan, 1975; Garibyan et al., 2013). Pruritus is considered a pathologic condition that significantly impairs the animal's quality of life and affects essential behaviors such as lying down and reposing (Metz et al., 2011). Several studies have monitored the rubbing behavior of *S. scabiei*-infected pigs, mostly to assess its value as an indirect tool to diagnose infection (Cargill and Dobson, 1979; Lee et al., 1980; Davies, 1995; Lowenstein et al., 2006). Results indicate that the number and duration of rubbing episodes are highly variable between infected pigs, and rubbing may be caused by other factors, making it a nonspecific and unreliable diagnostic method (Lowenstein et al., 2006). In experimental infections, Cargill and Dobson (1979) reported a negative relationship between increased rubbing and growth rate and the efficiency of food conversion. In contrast, Davis and Moon (1990a) concluded that experimentally infected pigs rubbed and scratched surprisingly less and were not significantly more active than noninfected pigs. These results contrast with the greatly increased rubbing behavior and reduced lying time of sheep infected with the non-burrowing skin mite *Psoroptes ovis* (Berriatua et al., 2001).

The present study was designed to acquire quantitative information on the nocturnal rubbing and lying behavior of fattening pigs exposed to natural infection in farms with moderate and high *S. scabiei* infection prevalence. This time of day was selected as it is primarily dedicated to rest and is void of behavioral changes related to human intervention. Moreover, the ethological sampling protocol used was similar to that in the previously mentioned *P. ovis* study, permitting a direct comparison of the effect of mange mites in different hosts.

## Materials and methods

### Study design and population and diagnosis of infection

Nocturnal rubbing and lying behavior was investigated in 54 randomly selected fattening pigs from 2 *S. scabiei*-infected farms, allocated to 4 cohorts: 1 acaricide-treated and 1 acaricide-untreated cohort on each farm. Pigs were born within 10 days of each other, and all other pigs born in the farm during this period were similarly untreated or treated. Acaricides used in both farms were injectable doramectin (Dectomax; Pfizer, Spain) in the dams 6 weeks before farrowing and their offspring from the age of 20–30 days every three weeks, as recommended by manufacturers, until 4 weeks before slaughter, and pour-on phoxim (Sarnacuran; Bayer, Spain) in offspring 2 weeks before slaughter.

Farms raised pigs intensively indoors for commercial purposes. *S. scabiei* prevalence 5 months before the commencement of the study was 3% and 82% (farms M01 and M10, respectively, Casais et al., 2013). *S. scabiei* prevalence and dermatitis were investigated again in cohort pigs and 303 other coetaneous pigs after slaughter to obtain a precise, up-to-date estimate of the prevalence of mange in the farm. To diagnose *S. scabiei* infection, the skin on the internal side of the ear pinna was scrapped and examined for mite stages under a stereomicroscope before and after skin digestion in potassium hydroxide (Goyena et al., 2013). The presence of hyperkeratotic dermatitis was investigated in the ear pinnae before taking skin samples. Hypersensitive dermatitis (HD) location and extension were assessed in the whole carcass after scalding by drawing areas with erythematous papular dermatitis onto individual pictures of a pig carcass and then estimating approximate lesion areas by multiplying the area on the paper by the picture scale. Results confirmed moderate infection in farm M01 and high

*S. scabiei* prevalence in farm M10, identified as farm M (moderately infected) and farm H (highly infected), respectively, for the present study (Table 1).

Blood samples were taken from cohort pigs when entering the fattening pens at the age of 3 months and immediately after slaughter at the age of 7 months to measure plasma histamine concentration. The daily weight gain of treated and untreated farm pigs was estimated by dividing carcass weight (provided by the abattoir) by the average pig's age (in days). The average pig's age was calculated by subtracting slaughter date from the fifth date of the study's 10-day farrowing period.

### Cohort size and husbandry and behavioral data collection

Behavioral cohort studies were done sequentially: untreated farm M (April–May 2011), treated farm M (May–July 2011), untreated farm H (August–October 2011), and treated farm H (November–December 2011). Untreated and treated cohort pigs included 15 and 11 animals in farm M and 15 and 13 animals in farm H (Table 1). Pigs were stocked in pens with concrete walls and partly slatted floors, at 1 m<sup>2</sup> per pig in farm M and 1.5 m<sup>2</sup> per pig in farm H and were fed cereal-based concentrates ad libitum.

Pig behavior was video recorded 24 hours a day using 2 strategically placed infrared cameras, allowing a complete view of the pen, connected to a digital video recorder. The frequency and duration of rubbing and lying behavior of pigs were measured by sampling continuous video recordings with a similar protocol as in a previous study of *P. ovis*-infected sheep (Berriatua et al., 2001). Behavior was analyzed 2 or 3 days weekly between 12 AM and 6.30 AM, by monitoring every other 30 minutes, for a total of 210 minutes per sampling day. Individual pigs were identified within each 30 minutes sampling; however, it was not possible to accurately follow individuals between days, so daily behavior data represented averages (see the following text).

A rubbing bout was defined as a single action of scratching the body with the hind leg or rubbing it against a fixed object (wall, door, or feed trough). Lying behavior interruptions were standing

**Table 1**

Prevalence of *Sarcoptes scabiei* mites and dermatitis and dermatitis area in acaricide-treated and untreated pigs from moderately (M) and heavily (H) infected farms at the age of 7 months (slaughter)

Untreated and treated farms and cohorts	No. pigs	With mites (%)	Hyperkeratotic dermatitis <sup>a</sup>	Hypersensitive dermatitis <sup>b</sup>	Area (cm <sup>2</sup> ), median (IQR <sup>c</sup> )
			Affected (%)	Affected (%)	
<b>Farm M</b>					
Untreated					
All <sup>d</sup>	124	16	2	67	142 (42–401)
Cohort <sup>e</sup>	15	27	0	80	283 (85–461)
Treated					
All <sup>d</sup>	47	0	0	44	51 (8–86)
Cohort <sup>e</sup>	11	0	0	55	42 (14–91)
<b>Farm H</b>					
Untreated					
All <sup>d</sup>	118	76	33	69	416 (130–602)
Cohort <sup>e</sup>	15	79	43	7	278 (8–466)
Treated					
All <sup>d</sup>	85	0	0	19	63 (41–115)
Cohort <sup>e</sup>	13	0	0	0	—

IQR, interquartile range; No, number.

<sup>a</sup> Visible crusts in the ear pinnae typically associated with chronic mange.

<sup>b</sup> Erythematous papules in body skin after carcass scalding typically associated with acute mange.

<sup>c</sup> Interquartile range lesion size in affected pigs.

<sup>d</sup> Farm pigs examined.

<sup>e</sup> Group of examined pigs included in the behavioral study.

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