Available online at www.sciencedirect.com
ScienceDirect
Veterinary Parasitology 146 (2007) 271–280
veterinary parasitology
www.elsevier.com/locate/vetpar

Influence of *Ascaridia galli* infections and anthelmintic treatments on the behaviour and social ranks of laying hens (*Gallus gallus domesticus*)

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Received 5 May 2006; received in revised form 6 March 2007; accepted 9 March 2007

Abstract

In the present study, the effects of an experimental *Ascaridia galli* infection and anthelmintic treatment on the behaviour and social status of laying hens of two different lines were studied. Sixty white (Lohmann LSL; LSL) and 60 brown (Lohmann Brown; LB) hens were reared under helminth-free conditions. The hens of each line were divided into four groups. The birds in two of the groups were artificially infected with 250 embryonated *A. galli* eggs at an age of 27 weeks. The other two groups were kept as uninfected controls. One infection and control group was dewormed at 38 weeks of age and slaughtered 4 weeks later, contemporary with the other animals. Individual faecal *Ascaridia* egg counts (FEC) were performed 11 weeks *post-infection* (p.i.). Body weights, laying performance and egg weights were recorded regularly. Blood was taken to measure testosterone levels. The worm burdens established in the intestines were counted in the infected not treated group after slaughtering. In addition, 15 behavioural parameters were recorded by focal animal observation ($n = 10$ per group) of one infection (plus anthelmintic treatment) and one control group, according to the time-sampling method throughout the experiment. All agonistic interactions within the groups were recorded simultaneously on an ongoing basis, thereby allowing the calculation of an individual social rank index. The following results were obtained:

- Mean FEC and worm burden were higher ($p < 0.01$) in the LSL hens than in the LB hens, but their performances were not different ($p > 0.05$) from the controls.
- Infections with *A. galli* resulted in significant behavioural changes in both lines as the infected birds showed a higher food intake and lower locomotion activity during the prepatent and patent periods. After anthelmintic treatment, food intake decreased and locomotion increased.
- Behavioural changes were more pervasive in the infected LSL hens, as these hens also showed changes in ground pecking and nesting activity not only during the prepatent and patent periods, but also after anthelmintic treatment.
- Social rank did not significantly change as a consequence of *A. galli* infection, but the infection groups of both lines had a tendency to display more agonistic activity than the non-infected controls.
- Serum testosterone values only increased significantly in the LSL hens during the patent period compared to the controls.
- No significant correlations were apparent between serum testosterone level, parasitic parameters, social status and/or aggressiveness in any of the groups.

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0304-4017/$ – see front matter
doi:10.1016/j.vetpar.2007.03.005

This study showed that even sub-clinical *A. galli* infections and their anthelmintic treatment can have an impact on animal behaviour.

Keywords: *Ascaridia galli*; Behaviour; Social rank; Treatment; Testosterone

1. Introduction

Animal welfare issues and changes in consumer demands have resulted in new regulations of the European Union laying down minimum standards for the protection of laying hens (Council Directive 1999/74/EC). As a consequence it can be expected that an increased number of birds will be kept in the future in alternative production systems such as free-range and floor husbandry. Because in these systems the animals are not separated from their faeces the prevalence and economic importance of helminth infections in chickens will increase. This impact on animal health, welfare and behavioural responses has to be taken into consideration for the evaluation of housing systems.

The nematode *Ascaridia galli* has been found to be a common parasite of laying hens in the above mentioned housing systems (Permin et al., 1999), because its direct life cycle and the environmental resistance of its eggs favour infections under these conditions (Ponnundurai and Chellappa, 2001). Infections with *A. galli* may cause, in addition to direct losses, reductions in growth rate, weight loss, reduced feed conversion rates (Ramadan and Abou Znada, 1991) and damage to the intestinal mucosa, leading to blood loss and secondary infections (Ackert and Herrick, 1928). In addition to these serious consequences, infections may interfere with behaviour, social rank (Rau, 1983, 1984; Zuk et al., 1998) and serum testosterone levels (Zuk et al., 1998; Roepstorff et al., 1999). An increased testosterone level in laying hens can lead to changes in group hierarchy and as a consequence an increase in agonistic interactions (Allee and Foreman, 1955; Mench and Ottinger, 1991) resulting in stress and reduced performance (Anthony et al., 1988). Furthermore host food intake is often altered during the course of infection with eukaryotic parasites (Crompton, 1984). The onset in the reduction of host food intake varies according to the species of parasite involved and may be related to a particular developmental stage or event during the course of the host-parasite relationship (Crompton, 1984; Thompson, 1990; Kyriazakis et al., 1998). Reduced food intake or even anorexia is a major factor contributing to the reduced performance of parasitised animals (Coop and Holmes, 1996). Conversely, anthelmintic treatments may lead to opposite effects. Because results of various studies indicated that some chicken breeds may be more resistant to parasitic infection than others (Buchwalder et al., 1977; Gauly et al., 2001, 2002; Schou et al., 2003) the impact of infections and treatments may be different for animals and has to valued different.

However, the impact of parasite infections on behaviour, agonistic interactions, direct and indirect damages may lead to new animal welfare problems in alternative housing systems which probably neutralise partly the positive welfare effects of this systems when compared with cages.

Therefore, the aim of the present study was to investigate the influence of an infection with *A. galli* on the behaviour patterns, agonistic interactions, social rank, health, serum testosterone levels, and performance of laying hens of two different lines. Furthermore, the effects of an anthelmintic treatment on these parameters were studied.

2. Materials and methods

2.1. Animals and management

The studies were carried out between December 2001 and February 2003 at the Research Station of the Department of Animal Breeding and Genetics, Giessen. In two consecutive experiments, 60 white (LSL) and 60 brown (LB) chickens marked with numbered wing tags were purchased from a commercial breeder at the age of one day and reared under helminth free conditions in cages.

At an age of about 20 weeks the birds of both lines were randomly allocated to four different groups ($n = 15$) (Table 1). Two groups (groups 1 and 2) were infected with *A. galli* at 27 weeks of age and two groups (groups 3 and 4) were kept as uninfected controls. Each group was placed in an identical pen (each measuring 4.55 m^2; 0.282 m^2 per animal) in a windowless room. The groups were isolated from each other by wooden walls, 35 cm high with wire extending to the ceiling. All the pens had concrete floors covered with a mixture of straw and sawdust. The pen litter was removed and renewed every second week. Three single nests (0.32 m^2) were located by the back wall of each pen.