Development of prevention and treatment strategies for parasites in poultry

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Abstract

*Parasitic infections are likely to be more important in organic and other free-range hens than in birds kept indoors. Several workpackages of QLIF aim at improving prevention and therapy of helminth (*Ascaridia galli *and* Heterakis gallinarum*) and arthropod (*Dermanyssus gallinae*) parasites of laying hens. This paper is a summary of the work undertaken in the first 3 years of QLIF.*

Introduction

The risk of parasitic infections is elevated in hens and pigs in free-range systems, as required in organic farming, compared to systems without outdoor runs (Permin *et al.*, 1999; Thamsborg *et al.*, 1999; Permin *et al.*, 1999). Effective alternative methods for controlling parasites in monogastrics are almost completely lacking and the use of conventional antiparasitic drugs is the rule on organic as well as on conventional farms, although the extent of use may vary.

Two WPs in QLIF are dedicated to this subject. This paper gives an overview of the work carried out with poultry parasites and presents some results obtained so far.

Endoparasites

Introduction

The parasitic situation is particularly critical in the control of helminths of laying hens, because only one anthelmintic (Flubendazole) is registered for this indication. This extensively used substance leads to residues in eggs; managing this issue presents a major problem for organic egg production. The roundworms *Ascaridia galli* and *Heterakis gallinarum* are the most important parasitic species in the intestines of poultry. Routine anthelmintic treatments are usually applied in laying hens in order to control these Ascarids, whose eggs generally have a long survival rate in the environment, and thus a high infection potential.

Preventive strategies are less effective in monogastrics than in ruminants, because of the different epidemiology of the helminth species involved, but still proper management is the basis for the prevention of helminth infections. Good hygiene of houses is essential for the prevention of an accumulation of the long-lasting infective parasite eggs over time. Thorough cleaning of the house and “wintergarden” is only possible between flocks. The outdoor run cannot be disinfected in order to destroy infectious stages and, therefore, alternative strategies have to be elaborated.

Results of a Danish study (Schou *et al.*, 2003) suggest that the epidemiology of *A. galli* infections in chicken may be influenced by a genetic component of the host. (Gauly *et al.*, 2002) observed significantly higher fecal egg outputs in white laying

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hens than in brown hens; they estimated sufficiently high heritabilities for fecal egg counts to allow for selection for *A. galli* resistance in chicken. However, parasite resistance is not a major criterion in poultry breeding at present.

Worldwide, a variety of plants have been shown to affect survival and/or reproduction of helminths of chicken and pigs *in vitro* or *in vivo*; in some cases, severe side effects on the host have been observed after the administration of certain plant products (e.g. Akhtar and Riffat, 1985; Javed *et al*., 1994; Satrija *et al*., 1994).

Coccidia (protozoan parasites in the intestines of poultry) are considered as one of the most severe health and welfare problems in poultry. In the last years, a vaccine based on attenuated strains of the relevant *Eimeria* spp. has been successfully implemented in organic production of chicken and additional measures are usually not necessary.

The following sections briefly describe the QLIF-experiments aiming at prevention and control of *A. galli* and *H. gallinarum* under organic farming conditions.

Materials and Methods

In a three-year study, the effects of three different types of outdoor runs with increasing grass cover on helminths were assessed in small flocks of laying hens (WP 4.1.1.1). In year 1, hens with natural helminth infections had been used to contaminate the runs. In years 2 and 3, parasite naive young layers were put on the contaminated runs. The runs of the groups were managed according to different regimes:

- “overused” old poultry run, large areas without grass cover
- “ideal” new run, almost no bare areas and a regular grass cover
- “extensive” run with structures and natural or artificial shelters, not mown.

The experiment was replicated on 4 farms in Switzerland. Fecal egg counts were performed monthly and worm burdens were determined in each flock after slaughter. The infectivity of the runs was repeatedly determined directly and with tracer animals and the vegetation in the runs was recorded monthly.

In a second experiment, the effects of three different litter management regimes on helminth infestations are assessed by means of fecal egg counts and worm burdens of tracer animals (WP 4.1.1.2). The experiment will finally include 6 farms and is still ongoing.

A third experimental series is dedicated to finding alternatives to conventional treatments of *A. galli* (WP 4.2.1.2). In several experiments, either laying hens naturally infected with *A. galli* and *H. gallinarum* or pullets with artificial *A. galli* infections are fed with promising anthelmintic plant products identified in a literature survey. Fecal egg counts are made during the feeding period and worm burdens are determined after slaughter at the end of the feeding period. In a second step, selected plant products are tested under semi-practical or practical conditions in layer flocks.

Results

The run management experiment is finished, but complete results are only available from the two first flocks at present. Hens on one farm had low prevalences of Ascarids and a low average FEC. On the other farms the prevalences of Ascarids as well as the average FECs were lowest in the “extensive” runs, whereas the “overused” and “ideal” runs were comparable. *A. galli* and *H. gallinarum* are present on all farms and in all flocks; the low FEC on one farm reflect low numbers of *A. galli* found in the hens of this farm. Tapeworms and *Capillaria spp.* occur in a substantial proportion of the hens.

At the end of the second vegetation period, the proportion of bare soil has increased in all the runs on all farms except for the “ideal” runs on farm 1, 3, and 4. As after the first season, the proportion of bare soil is higher in the “overused” runs (up to 100%) than in the other two run types.

Data of the litter management experiment are not presented, because the experiment is still running on most of the farms.

Six plant products were fed to layers naturally infected with *A. galli* and *H. gallinarum* in two experimental series. In four other series, nine products have been administered in various concentrations to hens artificially infected with *A. galli*. None yielded significant fecal egg count reductions or reductions of *A. galli* burdens. Tests with higher concentrations of the respective products are ongoing.

Discussion

Developing management measures for prevention of Ascarid infections in poultry is a difficult task due to the epidemiology of the species involved. It may be possible to identify advantages of some management elements after the completion of the experiments undertaken in QLIF, but it is still a question whether those are efficient if applied alone.

Ectoparasites

Introduction

The poultry red mite *Dermanyssus gallinae* is the most important ectoparasite of laying hens in organic as well as in conventional egg production in Europe (Maurer *et al*., 1993, Höglund *et al*., 1995). The haematophagous mite is a nocturnal feeder and spends the day in the surroundings of the hens. At high population densities poultry red mites can cause severe anaemia; already low mite populations irritate the hens to an extent that they refuse to go into the henhouse or rest on the perches. Controlling the mite during flocks is difficult.

In Switzerland, a three-stage management system for the control of *D. gallinae* on organic farms is currently applied. As a first step, the empty houses are cleaned and disinfected between flocks. Second, mechanically or physically acting substances (e.g. oils or silicas) are applied preventively or as a treatment when infestations are first detected. As a third step, acaricides of natural origin are applied if necessary.

Within the project QLIF, the effectiveness of measures including all three stages is evaluated.

Materials and Methods

Different levels of cleaning and disinfection are evaluated in commercial layer houses in a split farm design with 3 levels on 5 farms (WP 4.1.2.1). Mites are sampled monthly in mite traps placed in the houses.

Promising alternatives to conventional treatments of *D. gallinae* are tested *in vitro* and on farm (WP 4.2.1.1). In an *in vitro* assay, silicas (5 products), plant and mineral oils (4 products), plant extracts (14 products), and commercially available products declared as natural acaricides for red mite control (5 products) have been tested in several concentrations. The effects on survival of female mites are described by means of AUDPC-values, an integration of the survival curve. The 2 most promising alternatives will be tested in 5 layer houses and the effects on mite populations evaluated by means of mite traps.

Results

The experiments in WP 4.1.2.1 have only started in autumn 2006, data on the effects of cleaning and disinfection are therefore not yet available.

In the *in vitro* tests (WP 4.2.1.1), several plant extracts and oils significantly reduced the survival of *D. gallinae* females, but not all the commercially available products were more efficient than their controls. Diatomaceous earth (DE) without acaricides was at least as effective as DE supplemented with pyrethrum or essential oils and a liquid formulation of silica *in vitro*. In the first on farm experiments undertaken, DE was effective during a limited period only, whereas the liquid formulation had a very good residual effect over several months (Maurer & Perler, 2005).

Discussion

The strategy for red mite control based on cleaning and disinfection and use of mechanically acting substances can be improved by the dispersion of liquid silicas, when they are available for organic farmers. Several effective acaricidal products of natural origin are available or under development. Incorporating those in artificial aggregation sites for *D. gallinae* as described by Chirico & Tauson (2005) and Lund *et al*. (2002) is possibly a more efficient application than spraying poultry houses with those relatively expensive products.

Conclusions

Endoparasites

In the second half of QLIF, tests with feed components with potential anthelmintic properties will continue (WP 4.2.1.2) and the experiments for evaluation of preventive measures (WP 4.1.1.2) will be finished. In parallel, epidemiological studies will be started and the genetic component of the hen will be evaluated in order to fill gaps of knowledge which are constraining the development of preventive measures.

Ectoparasites

The remaining experiments will focus on the further development of preventive strategies against *D. gallinae* (WP 4.1.2.1) and on the application technique for natural products in commercial poultry houses (WP 4.2.1.1).

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References

A list of references is available from the first author.