Journal of Helminthology (2007) **81,** 101–103 DOI: 10.1017/S0022149X07251211

How effective is pre-release nematode control in farm-reared red-legged partridges *Alectoris rufa*?

D. Villanúa[1], L. Pérez-Rodríguez[1], O. Rodríguez[2], J. Viñuela[1] and C. Gortázar[1]*

[1]Instituto de Investigación en Recursos Cinegéticos IREC (CSIC-UCLM-JCCM), Ronda de Toledo s/n, 13071 Ciudad Real, Spain: [2]EBRONATURA S.L., c/ General Aguilera 3, 13001 Ciudad Real, Spain

Abstract

Game bird farming is associated with high parasite levels that reduce farm productivity, reduce survival after releasing, and may pose a health risk for natural populations. The efficacy of albendazole (orally, 20 mg kg^{-1}) was evaluated in farmed red-legged partridges naturally infected with the nematodes *Aonchotheca caudinflata* and *Heterakis gallinarum*. In treated birds body condition improved, nematode egg deposition was reduced and the proportion of gravid *A. caudinflata* females was reduced, but not the overall worm burdens. Albendazole was found to be 36.8% and 17.1% effective against *A. caudinflata* and *H. gallinarum*, respectively. These results indicate that the anthelmintic treatment used normally in Spanish partridge farms is not effective enough to avoid the introduction of parasites into the field after release.

Introduction

The red-legged partridge *Alectoris rufa* is one of the most important game birds in Spain with more than 5 million individuals shot yearly (Millán *et al.*, 2004). Natural populations have declined considerably during the past decade, leading to an important increase in partridge releases to supplement stocks for shooting (Millán *et al.*, 2003). The release of farmed animals can involve a risk to wild populations due to the possible introduction of new parasites into the field (Tompkins *et al.*, 2002; Millán *et al.*, 2004).

The present study evaluates the efficacy of albendazole, one of the most widely used anthelmintics in Spanish partridge farms (Asociación Productores de Caza (APROCA), 2004), to prevent the introduction into the field of two nematodes, *Aonchotheca caudinflata* (Holger-Madsen) and *Heterakis gallinarum* (Schrank), which are exclusively found in farm-reared partridges, but not in wild ones (Millán *et al.*, 2004).

*Author for correspondence
Fax: +34 426 29 54 51
E-mail:christian.gortazar@uclm.es

Material and methods

The study was carried out on 16-month-old red-legged partridges during a natural capillarid outbreak in a partridge farm in Ciudad Real, central Spain. In September 2004, eight randomly selected birds from the infected outdoor pen were isolated in individual elevated wire cages. Faecal samples were obtained on day 0 at dusk (time of the day of maximal nematode egg excretion, Villanúa *et al.* 2006) for a quantitative coprological analysis in MacMaster chambers as described by Mehlhorn *et al.* (1992), which confirmed the infection of all birds with capillarid nematodes (later identified as *Aonchotheca caudinflata*).

Five randomly selected individuals were treated orally with 20 mg kg^{-1} of albendazole (Albendavet®, Divasa Farmavic, S.A.) on day 1 and day 15, according to the manufacturer's instructions. The same volume of water was given as a control to the other three infected birds. Fifteen days after the second administration all birds were humanely sacrificed and necropsied. The necropsy included a second coprological analysis and the examination of the digestive tract for parasites using a stereomicroscope. The efficacy (E) of albendazole

treatment on worm burden was calculated as follows after Reina *et al.* (2000):

$$E = \frac{\text{Geometric mean of control animals} - \text{geometric mean of treated animals}}{\text{Geometric mean of treated}} \times 100$$

The nematode sex ratio (SR) and fertility (F) were calculated as follows after Kassai (1998):

$$SR = \frac{\text{Number of female nematodes}}{\text{Total number of nematodes}}$$

$$F = \frac{\text{Number of gravid females}}{\text{Total number of females}}$$

The body condition of each partridge was estimated using three different methods, namely an arbitrary score of the degree of fat deposition (1 to 5), the pectoral angle as a measure of the width of pectoral muscles after Millán *et al.* (2003), and the residuals of the regression of body weight on tarsus length after Andersson (1992). The effect of albendazole treatment on propagule excretion, number of adult worms and partridge body condition was analysed using non-parametric statistics (Wilcoxon matched pairs tests and Mann-Whitney U tests), as recommended by Kassai (1998) for studies with natural infections. Differences in nematode sex ratio and fertility were analysed using Chi^2 tests.

Results

All birds deposited eggs of capillarid nematodes immediately prior to the experiment. This deposition decreased significantly (−90.75%) after treatment in the medicated group (Wilcoxon test; $Z = 2.02$; $P < 0.05$) but not in control birds, where deposition was even higher (+80.67%) in the second analysis (Wilcoxon test; $Z = 1.6$; $P > 0.05$) (fig. 1). After treatment, dosed birds showed higher values for fat index, pectoral angle and residual body weights than control birds (fig. 2). However, only an increase in relative body weight of the dosed group was significant when comparing pre- and post-treatment values (Wilcoxon test; $Z = 2.02$; $P < 0.05$).

Albendazole was shown to have a limited effect against adult *Aonchotheca caudinflata* with an effectiveness of 36.8%. Neither a reduction in worm number, nor a change in worm sex ratios reached a 95% significance level. However, the fertility of female *A. caudinflata* from treated

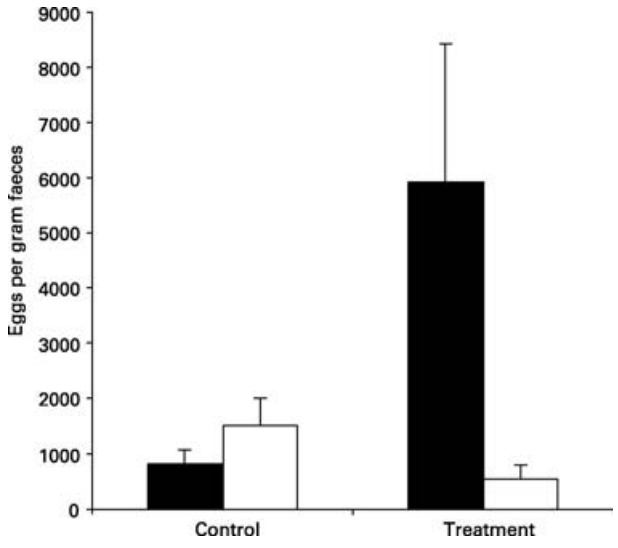

Fig. 1. Deposition of *Aonchotheca caudinflata* eggs per gram of faeces before (■) and after (□) treatment with albendazole (mean + SE).

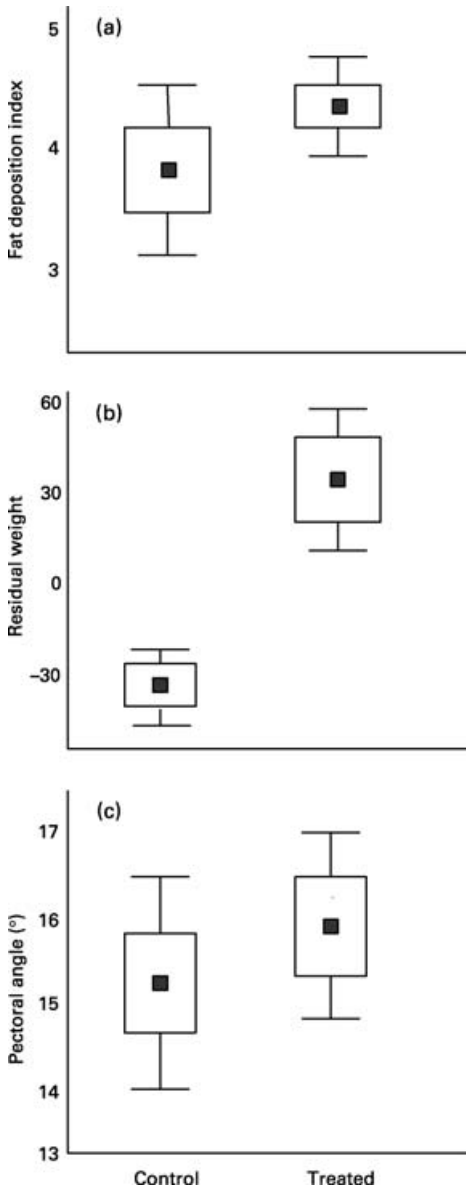

Fig. 2. Body condition of control and albendazole treated red-legged partridges as reflected by (a) fat deposition index (in an arbitrary scale from 1 to 5), (b) residuals of the regression of weight over tarsus length, and (c) pectoral angle (expressed in degrees). Mean (■), SE (□) and 95% C.I.().

https://doi.org/10.1017/S0022149X07251211 Published online by Cambridge University Press

Table 1. Efficacy of albendazole treatment on the mean worm establishment of *Heterakis gallinarum* and *Aonchotheca caudinflata*, and on the sex ratio and fertility of *A. caudinflata* in red-legged partridges.

	Treated birds		Control birds			
Nematode species	Mean	SD	Mean	SD	Statistical analysis	Efficacy
Heterakis gallinarum	5.8	6.6	7	7.8	$Z = 0.74$; $P > 0.05$	17.14%
Aonchotheca caudinflata	20.2	21.2	32	20.4	$Z = 0.75$; $P > 0.05$	36.87%
A. caudinflata sex ratio	0.42	0.20	0.43	0.01	$X^2 = 1.03$; df = 1; $P > 0.05$	
A. caudinflata fertility	0.51	0.30	0.68	0.19	$X^2 = 5.43$; df = 1; $P < 0.05$	

partridges was significantly lower (51.0%) than in controls (67.7%) (table 1).

Heterakis gallinarum, not detected by coprological analysis, was found in the intestinal tract of all birds. No significant difference in worm burden was found between treated and control birds (table 1) and no females were gravid. The effectiveness of the albendazole dose on *Heterakis gallinarum* was only 17.14%.

Discussion

Despite a small sample size, the results show a limited effect of albendazole treatment on *Aonchotheca caudinflata* and *Heterakis gallinarum* infection, with an efficacy that is lower than that described for other benzimidazole anthelmintics in different galliforms. Fenbendazole for example was 99.2% effective against *Capillaria* species when administered to chickens for 6 days in feed (Taylor *et al*., 1993). Kirsch (1983) reported that administration of 100 ppm of fenbendazole in feed to ring-necked pheasants *Phasianus colchicus* and grey partridges *Perdix perdix*, for four consecutive days, reduced the deposition of *Heterakis gallinarum* and *Capillaria obsignata* eggs and the number of adult worms by more than 90%. In the present study, a similar reduction in *Capillaria* egg counts was obtained, but not in worm burden. This suggests that albendazole has some limiting effect on the reproduction of nematodes, but it does not eliminate the infection. This may be due to an insufficient dosage. Although the dose administered in the present study was that recommended for chickens by the manufacturer, future studies should confirm whether a dose increase would improve the efficacy of the treatment.

In conclusion, the present results show that treatment currently used by game bird farmers in Spain may help to improve body condition of farm-reared partridges, but this is not enough to avoid the introduction of parasites into the field after release. Alternative drugs, higher doses, or other administration methods must be evaluated. This study also shows that coprological analyses alone are not enough to ensure the absence of a given nematode species in farm-reared birds. Sanitary screenings of farm-reared birds should preferably include some complete necropsies, for example of casualties, rather than rely exclusively on non-invasive sampling.

Acknowledgements

This research contributes to the agreement IREC - Principado de Asturias. The authors acknowledge Galiana facilities (FGUCLM) and thank E. Pérez and F. Talavera for their help. L. Pérez-Rodríguez has a FPU grant and O. Rodríguez a Torres Quevedo contract partly supported by MEC. Two referees much improved the manuscript.

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(Accepted 26 September 2006)