Control of bovine fasciolosis in dairy cattle in Switzerland with emphasis on pasture management

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Thirty-two dairy cattle farms with fasciolosis as an established herd problem were visited and divided into groups according to the location of the habitats of the intermediate host of Fasciola hepatica. The farms were revisited 4-5 years later and those that had followed the recommended measures were compared to those that had not. Egg shedding and seroprevalence was significantly reduced in cows on farms complying with the control recommendations but was not reduced on farms that had not complied.
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Abstract

Thirty-two dairy cattle farms with fasciolosis as an established herd problem were visited and divided into groups according to the location of the habitats of the intermediate host of *Fasciola hepatica*. The farms were revisited 4-5 years later and those that had followed the recommended measures were compared to those that had not. Egg shedding and seroprevalence was significantly reduced in cows on farms complying with the control recommendations but was not reduced on farms that had not complied.

Keywords: *Fasciola hepatica*; Bovine fasciolosis; Disease control; Pasture management
Introduction

Fasciolosis, caused by *Fasciola hepatica*, is a widespread parasitic disease in cattle and sheep in Switzerland. Mean prevalence in cattle has been reported to be 8.4-21.4% (Eckert et al., 1975; Ducommun and Pfister, 1991; Schweizer et al., 2003; Rapsch, 2005; Rapsch et al., 2006). The economic importance and control of fasciolosis has previously been investigated by several authors (Boray, 1972; Ribbeck and Witzel, 1979; Hope Cawdery, 1984). The estimated mean losses in Switzerland amount to €52 m\(^1\) per year (95% CI €22–92 m; Schweizer et al., 2005a) resulting in a cost of €299 per infected animal. Most of the losses arise from reduced milk yield and reduced fertility, and smaller losses are due to reduced meat production and the condemnation of livers (Schweizer et al., 2005a).

Control measures for fasciolosis include anthelmintic prophylaxis with drugs such as triclabendazole (Endex, Novartis), fencing and draining of the habitats of the intermediate host snail *Galba truncatula*, and pasture management strategies (Boray, 1971; Boray, 1972; Torgerson and Claxton, 1999). The benefit of pasture management strategies lie in the reduction of contamination of the pastures with *F. hepatica* eggs. To achieve this, pastures of a farm are divided into areas with snails and areas without snails. Because the pre-patent period of liver fluke is at least 8 weeks, animals can be allowed to graze on pastures with snail habitats for a maximum of 8 weeks before being moved to pasture without snails once it was possible that fluke eggs could appear in the faeces.

Before being put onto pasture containing snail habitats, cattle were drenched with an effective flukicide to prevent introduction of infection. In regions where cattle graze on pasture all year, areas without snails are grazed from February to May. Then, fluke-free cattle are allowed to graze on pasture with snail habitats for 8 weeks followed by grazing on snail-

\(^1\) €1 = approx. £0.87, $1.38, at 8 June 2009.
free lots from August to November. After treatment with a flukicide animals can then graze on pasture containing snails in December and January. In regions where cattle are housed indoors through winter (as in Switzerland), animals are turned out onto snail-free pasture during the first months of grazing, then they are allowed to graze on pastures containing snails for a maximum of 8 weeks, followed by grazing on safe lots for the remainder of the grazing period. Additionally animals must be treated with a flukicide before grazing on infectious pastures (Boray, 1971).

Even though triclabendazole is highly efficient against adult and juvenile stages of *F. hepatica*, it is rarely used in lactating dairy cows due to the long milk withdrawal periods (Rapic et al., 1988; Shi et al., 1989). In Switzerland, the withdrawal period for milk is 12 days in order to reduce the concentration of triclabendazole to a maximum of 0.01 mg per kg milk (Anonymous, 1995). As a result, cows are often treated with triclabendazole once per year during the dry period, although treatment up to four times a year may be necessary to attain a significant decrease of the prevalence in a herd (Parr and Gray, 2000; Torgerson and Claxton, 1999). If the safe pasture rotation system outlined above is used flukicides effective against the adult stage only can be used, because mature flukes only will be present after two or more months if the animals are grazing on un-infested pasture.

This study compares the results in terms of reduction in fasciolosis on farms that followed specific control recommendations compared to those farms that were not compliant. In all cases the control strategy was designed according to the specific epidemiology found on the individual farms.

**Material and methods**
Between February 1999 and February 2000, 70 herds infected with *F. hepatica* were identified by back tracing animals that had livers condemned due to fasciolosis at abattoir inspections. Thirty-two of 70 identified farmers were willing to take part in this study and were visited in the summer of 1999 or 2000 and again in the summer of 2004. The parasite cycle on the farm was demonstrated following faecal examination of five cows per herd (160 cows in total), the finding on the farm of *G. truncatula* and the presence of *F. hepatica* DNA in the intermediate host (quantitative real-time PCR; Schweizer et al., 2007).

The farms were given control recommendations based on the location of the snail habitats. These were:

1. **Recommendation A** (nine farms): Snail habitats were found on pastures used for young stock (prior to first calving) or dry cows, meaning that the animals would graze there up to 8 weeks at any time throughout the summer. Pastures for dairy cows were not affected. Treatment with triclabendazole was recommended after bringing the animals off the infectious pasture.

2. **Recommendation B** (three farms): Snail habitats were found on all pastures used for dairy cows. It was recommended that all animals were treated with triclabendazole staggered over the winter, preferably during the dry period. The staggered treatment is supposed to minimise losses due to the 12-day milk withdrawal period. The milk from treated cows can either be fed to young breeding calves or must be discarded. Additionally treatment of dry cows during summer period was advised.

3. **Recommendation C** (20 farms): On these farms, habitats were found in single pastures used for dairy cows. Therefore the pasture rotation system described by Boray (1972)
was recommended. Cows were treated with triclabendazole once, before grazing on the infectious pastures, preferably during the dry period. Animals were then turned out on pastures without snail habitats in spring. In June and July cows could graze on infectious pastures but had to be moved to pastures without snails before shedding eggs (Boray, 1971, 1972).

To avoid infection from stored feed, all farmers were instructed to feed grass from infected land either as barn dried hay (with ventilation) or as silage. To prevent introduction of new infections, all new animals introduced to the group (e.g. purchased animals, young animals after first calving) were treated with triclabendazole before turning them out on pastures with snail habitats. All recommended measures were based on the fact that young stock and dairy cows are turned out on separate pastures. Dry cows are often grazed with young stock or separately, depending on the number of pastures available.

The control recommendations based on the results of the first visit (including results of the sample collection and the assessment of the snail habitats) were sent to the farmer and the contract veterinarian in order to enhance compliance.

During the second visit in summer 2004 farms were divided into two compliance groups:

(1) Group 1 (15 farms): Farmers following the recommendations.

(2) Group 2 (17 farms): Farmers following the recommendations only partially (i.e. only treating the dry cows) or not at all.
The presence of *F. hepatica* in cattle was recorded and the farmers interviewed in regard to the implementation of the control recommendations. All farmers were informed of the results of the second collection.

**Samples**

On both visits at each farm faecal samples from five cows selected by the farmer were examined for *F. hepatica* by the sedimentation technique (Eckert et al., 2005). Pastures were searched for possible habitats for *G. truncatula*. On the second visit, blood samples from all cattle were examined for antibodies against *F. hepatica* using a commercial test kit (ELISA Fascioliasis Serum and Milk Verification, Institut Pourquier; Reichel, 2002).

**Statistics**

Office Excel 2002 (Microsoft Corporation), SPSS 11.5.0 (LEAD Technologies) and the statistical software R 2.2.0 (The R Foundation for Statistical Computing\(^2\)) were used for the statistical analysis.

The outcome was assessed depending on the compliance to an integral control strategy (group 1) compared to poor control (group 2). A linear modelling approach was used with the proportion of seropositive animals as the dependent variable. This was to ensure that any factors that could independently account for reduction in fasciolosis (other than treatment compliance) were included in the analysis. Independent variables included compliance, number of positive cows on the first visit, month of sampling, altitude of farm, number of stock on the farm, and pasture area. A backward stepwise analysis was undertaken where variables having a *P* > 0.25 were eliminated from the model at each step. The data were also weighted according to the numbers of cattle that were serologically tested on the second visit.

\(^2\) See: [http://CRAN.R-project.org](http://CRAN.R-project.org)
Results

Farms

The mean herd size was 21.9 ± 9.5 cows (range 8 – 52)\(^1\) with 18.0 ± 15.0 young stock (range 0 – 80). On 25 farms the cows were held in tie stalls and on seven farms in pens. Mean annual milk yield amounted to 6752 ± 775\(^3\). Mean farm acreage was 22.5 ± 11.2 ha and mean pasture area 11.8 ± 9.7 ha. According to Swiss welfare regulations, cows must be turned out on pastures for a minimum of 60 days staggered over the summer months. Usually cows are turned out as often as weather conditions allow so the animals graze throughout the summer for half or whole days, allowing milking twice daily in the stable. Additionally, during the summer when cows are housed for milking, grass, hay, or silage is provided, depending on weather conditions. In winter hay or silage is fed.

Compliance with the control recommendations

Fifteen farmers reported that they had fully followed the control recommendations and 17 partially (mainly treating the dry cows with triclabendazole) or not at all (Table 1). The 15 farmers applying the recommendations correctly said they found them easy to follow.

Of the 17 farmers that did not comply, seven said they could not follow the recommendations for technical reasons: either there was not enough pasture for rotations or the pasture with the snail habitat could not be used for harvesting grass only for grazing. Six farmers did not follow the recommendations owing to lack of interest, two applied the wrong pasture rotation range and one used the wrong anthelmintic (doramectin). The management

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\(^1\) In 2002 the mean number of cows per owner in Switzerland was 15.7 and the mean milk yield was 5500 kg. See: [www.bauernverband.ch](http://www.bauernverband.ch)
of one farm changed during the trial period and so the control of fasciolosis was discontinued.

Six of the 17 non-compliant farmers treated their dry cows with triclabendazole.

Prevalence in cattle

Of the faecal samples tested 32.5% were positive for *F. hepatica* on the first visit. On farms with poor control the proportion of positive samples did not change. On the farms following the control recommendations the percentage of positive faecal samples decreased from 30.7 to 9.3% (*P* = 0.003, $\chi^2$). On the first visit no difference was found between the three control recommendations groups (*P* = 0.64, $\chi^2$), but on the second visit the difference was significant (*P* < 0.001, $\chi^2$) (Table 1). On the farms complying with the recommended control strategies, the mean seroprevalence in cattle was 21.4%. In contrast, on farms with poor compliance the mean seroprevalence was 62.1% (*P* <0.001, $\chi^2$).

The results of the multivariate linear regression model verified that the decrease in seroprevalence was associated with good compliance rather than confounded by a correlated variable (*P* < 0.0001). Herds with a high prevalence on the first visit also had a high prevalence on the second visit. In addition the number of faecally positive cattle detected on the first visit was associated with the level of seropositivity detected on the second visit (*P* = 0.0044). All other factors (month of sampling, altitude of farm, stocking density and size of farm) were not significant in the model.

**Discussion**

Because bovine fasciolosis is an important parasitic disease in Switzerland and economic losses amount to several thousand Euros per affected farm, control of this parasite is not only important for animal welfare but also for economic reasons. Several control strategies have been described (Boray, 1971; Harris and Charleston, 1971; Boray, 1972; Armour, 1975;
Schneider et al., 1975; Whitehead, 1976), but to the authors’ knowledge no studies have previously investigated the efficiency of control measures designed according to the individual epidemiological situation on a given farm. As the epidemiology varies, the control recommendations were based on location and use (young stock/dry cows vs. dairy cows) and the number of infectious pastures (single pastures vs. all pastures).

A total of 17 farmers failed to follow the recommendations. The 15 farmers that did comply with the recommendations found them easy to follow. Despite being informed about fasciolosis and the recommended measures for control, seven farmers were not motivated to take measures against the infection. Another seven showed interest in implementing control, but could not apply the recommendations because of the location of the grazing land on their farms. It was not possible for them to graze their stock on infectious pasture for 2 months only as the pastures were near to the farm whereas the ‘safe pastures’ were too far away for them to be used for longer periods in spring and autumn.

Interviews during the first visit revealed that most of the farmers were not aware of the economic importance of bovine fasciolosis (Schweizer et al., 2005b). Due to the information given within the scope of the interview, some 22 farmers appeared more educated about the disease indicating the importance of veterinarians providing appropriate information to farmers.

Six farmers started treating their dry cows with triclabendazole after the first visit, but failed to implement further measures for the reasons mentioned above. This single treatment is often suggested by veterinarians as it is easy to accomplish and has the lowest economic losses due to milk withdrawal. The present study shows, however, that a treatment of the dry cows alone does not decrease the prevalence of *F. hepatica* within the herd. The treatment of
an individual animal is reasonable to reduce its parasitic load (especially during the initial
phase of lactation) but at the herd level our data suggest this strategy will be ineffective. One
treatment will not prevent reinfection, especially during the pasture season. A continuous
intervention programme is needed to lower the level of infection in the snails which will then
lower the infection pressure on cattle (Parr and Gray, 2000).

In the present study, triclabendazole was recommended, as we felt compliance was likely
to be more likely if only one drug was used. As resistance to triclabendazole is an emerging
problem (Brennan et al., 2007), its use should be avoided in late winter when early immature
flukes are unlikely to be present.

Wherever possible, the rotational system described by Boray (1971, 1972) is
recommended, as it is easy to carry out and no structural measure such as draining pastures is
necessary. If a rotational system is not possible, then triclabendazole should be used twice a
year as a treatment in winter will prevent shedding of eggs in spring. An additional treatment
of dry cows (preferably in late summer or autumn) is beneficial for general health.

The successful reduction in parasite prevalence on the two farms that followed
recommendation B suggests that the key interference with the parasite cycle was provided by
the winter treatment and not by the treatment of dry cows. The importance of the winter
treatment has also been demonstrated in sheep (Taylor et al., 1994). To minimise economic
impact from triclabendazole’s 12 day withdrawal period, small groups of cows can be treated
in a staggered manner over the winter. In order to maintain the efficacy of triclabendazole,
another flukicide (e.g. Netobimin) may be used at the end of winter.
To decide which integral control strategy is likely to be most successful on a farm, it is essential to assess the location(s) of snail habitats on the pastures. Compliance with our recommendations appeared to significantly reduce the prevalence of *F. hepatica* in the definitive host. This was shown by comparing faecal examination and seroprevalence on both visits.

Under these epidemiological conditions, where no regular treatment was undertaken, serology has a high specificity (Rapsch et al., 2006). In animals that are regularly treated, the specificity will be lower as exposure, seroconversion and treatment will result in circulating antibodies and no liver fluke. Seroprevalence in the compliant farms would have been expected to be lower than the observed test prevalence as the cattle had been treated and more of the seropositives will be false positive compared to non-compliant farms. Thus the difference in infection rates could well be higher than those actually reported.

In this study, only farms were considered where animals become infected directly by grazing on pastures. The parasite cycle can also be maintained by using manure on hayfields and feeding the cut grass to housed cattle. In this case, the grass should be treated prior to feeding, either by barn drying or making silage, as the metacercariae will not survive these procedures (Enigk and Hildebrandt, 1964; Enigk et al., 1964).

Conclusions

Following a control strategy designed according to the specific epidemiology found on the individual farm can significantly reduce egg shedding and seroprevalence in cattle infected with *F. hepatica*. Advice and support by the contract veterinarian is of crucial importance for the compliance of the farmers.
Conflict of interest statement

None of the authors of this paper has a financial or personal relationship with other people or organisations that could inappropriately influence or bias the content of the paper.

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Table 1: Compliance with control recommendations on 32 farms with bovine fasciolosis

<table>
<thead>
<tr>
<th>Affected pastures</th>
<th>Control recommendation</th>
<th>Compliance group</th>
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<td></td>
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<td>Prevalence</td>
<td>Sero-prevalence</td>
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|                       |                                                                                       | first visit (faecal egg count) | second visit (faecal egg count)
|                       | Prevalence second visit (faecal egg count)                                             |                  |                  |
|                       | Sero-prevalence second visit (faecal egg count)                                        |                  |                  |
| Young stock and/or dry cows | Recommendation A: Triclabendazole after removal from affected pasture                     | 20.0% (5 farms) | 15.5% (129 cattle) |
|                       |                                                                                        | 8.0% (5 farms)  | 25.0% (4 farms)  |
|                       |                                                                                        | 15.5% (129 cattle) | 45.0% (4 farms) |
|                       |                                                                                        |                  | 51.5% (101 cattle) |
| All dairy cows        | Recommendation B: - All animals: Triclabendazole in winter - Cows when dry all year            | 10.0% (2 farms) | 8.6% (58 cattle) |
|                       |                                                                                        | 0% (2 farms)   | 0% (1 farm)     |
|                       |                                                                                        | 8.6% (58 cattle) | 60.0% (1 farm) |
|                       |                                                                                        |                  | 45.0% (20 cattle) |
| Single dairy cows     | Recommendation C: - Triclabendazole once before grazing on affected pasture - Pasture rotations according to Boray (1971, 1972) | 32.5% (8 farms) | 29.8% (178 cattle) |
|                       |                                                                                        | 12.5% (8 farms) | 40.0% (12 farms) |
|                       |                                                                                        | 29.8% (178 cattle) | 28.3% (12 farms) |
|                       |                                                                                        |                  | 68.1% (238 cattle) |
| Mean                  |                                                                                        | 30.7% (15 farms) | 21.4% (365 cattle) |
|                       |                                                                                        | 9.3% (15 farms)  | 34.1% (17 farms) |
|                       |                                                                                        |                  | 34.1% (17 farms) |
|                       |                                                                                        |                  | 62.1% (359 cattle) |