

Effect of sainfoin (*Onobrychis Viciifolia*) silage and hay against gastrointestinal nematodes in lambs

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Keywords: development of organic agriculture, condensed tannins, animal health, animal nutrition

Abstract:

The objective of the study was to examine the effect of dried and ensiled sainfoin (Onobrychis viciifolia) against two species of gastrointestinal nematodes (Haemonchus contortus, Cooperia curticei) in lambs. Twenty-four days post experimental infection, 24 lambs were allocated to 4 equal groups. Group A and B received sainfoin silage and control silage respectively for 16 days. Groups C and D were fed on sainfoin hay or control hay for the same period. Feeds were administered ad libitum and mean refusals and live weight were regularly recorded. Individual faecal egg counts (FEC) were performed twice weekly. After the feeding period all lambs were slaughtered for post mortem investigation. The consumption of sainfoin hay was associated with a significant reduction of the adult H. contortus burden by 47 % ($P < 0.05$) whereas no significant difference was seen when feeding sainfoin silage (49 %, $P = 0.112$). The C. curticei worm burden was not significantly reduced by either sainfoin hay or silage. At slaughter FEC were significantly reduced by sainfoin hay by 64 % ($P < 0.001$) compared to the control feed. After feeding sainfoin silage FEC decreased by 48 % ($P = 0.056$). There was a tendency of better live weight gain in sainfoin hay fed animals compared to the control fed ones ($P=0.07$). These results demonstrate a nematocidal effect of a tanniferous forage legume against gastrointestinal nematodes, which was more pronounced against H. contortus. The antiparasitic effects were largely preserved when feeding sainfoin silage, suggesting this conservation procedure to be a valuable alternative to hay.

Introduction and Objectives:

Nematode infections of the gastrointestinal tract represent a major constraint in sheep husbandry, resulting in significant production losses (SYKES 1994). In contrast to various other diseases, control of parasitic nematodes in organic farms relies to a large degree on the use of conventional drugs. The intensive use of anthelmintics has lead to severe problems with drug resistance (JACKSON & COOP 2000). One of the currently investigated complementary approaches to reduce the dependence on anthelmintic drugs is the use of tanniferous plants. Controlled indoor and outdoor studies with sheep showed that the consumption of tanniferous legume forages like sulla (*Hedysarum coronarium*), big trefoil (*Lotus pedunculatus*) or birdsfoot trefoil (*Lotus corniculatus*) were associated with negative effects on host parasitism (MIN & HART 2002; HOSTE et al. 2006)}. In parasitized goats, promising results have recently been obtained with sainfoin (*Onobrychis viciifolia*) hay (PAOLINI et al. 2003 & 2005), documenting that the anti-parasitic effects were largely preserved when using a

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tanniferous legume in conserved form. However, to our knowledge no experimental work exists with ensiled tanniferous plant material, although this conservation procedure is often preferred by farmers in regions with moderately warm summer temperatures, which limit the hay production of several fodder plants.

The objectives of the current study were, to determine the effects of ensiled and dried sainfoin against a mixed experimental infection of an abomasal (*Haemonchus contortus*) and an intestinal (*Cooperia curticei*) nematode species.

Methods:

Four different experimental feeds were used. Sainfoin hay and silage were produced in summer 2004 from sainfoin monoculture swards. A maize-lucerne mixture silage and ryegrass / clover hay were used as control forages respectively. At the beginning of the experiment in early 2005, condensed tannin (CT) concentrations of all feeds were measured (TERRILL et al. 1992). Twenty-four Swiss White Alpine x Swiss Black-Brown Mountain lambs were inoculated with a single dose of 7,000 third stage larvae of *H. contortus* and 15,000 third stage larvae of *C. curticei*. On the basis of individual weight and of faecal egg counts (FEC) on day 24 post infection, lambs were restrictively randomised to one of four experimental groups A-D consisting of 6 animals each. From day 28 to day 44 (i.e. 16 days) groups A and B received sainfoin or ryegrass hay respectively. Group C and D were fed with either sainfoin silage or received maize-lucerne silage. Based on the consumption of the preceding day, feeds were supplemented with concentrates in order to make the rations of the different groups isoenergetic and isonitrogenous. Prior to the start of experimental feeding, all lambs received control hay and control silage. During the CT-feeding period individual faecal samples were taken from the rectum twice weekly for faecal egg counts. At day 45 post infection all animals were slaughtered and post mortem worm counts were performed.

All data were analysed using STATA® 9.0 (StataCorp LP, 4905 Lakeway Drive, Texas 77845, USA) software. Evidence of aggregated distributions for both FEC and worm burdens were confirmed. Aggregated data are defined as the variance being greater than the mean (TORGERSON et al. 2005). For FEC and worm burdens cross-sectional negative binomial regression models were therefore fitted separately for each point in time with the two parameters of the model being the arithmetic mean and the negative binomial constant. Comparisons were made between the (i) sainfoin hay and the control hay group and (ii) sainfoin silage and the control silage group. Equivalent comparisons were done for the worm burden

Results and Discussion:

CT-concentrations in conserved sainfoin, feed consumption and life weight gain:

Sainfoin hay had a higher CT-content than sainfoin silage (mean \pm S.E.M, 6.2 ± 0.5 % DM and 4.4 ± 0.9 % DM). The CT-concentrations measured in the two control feeds were very low. All feeds were readily eaten by the lambs throughout the study period (for detailed information on nutrient intake – please consult HECKENDORN et al. (2006). There was no significant difference in daily weight gain for the sainfoin silage group compared to the control silage group (mean \pm S.E.M. 64 ± 27 g and 84 ± 20 g). There was a trend of increased daily weight gain in the sainfoin hay group compared to the control hay group (mean \pm S.E.M. 163 ± 20 g and 96 ± 27 g; $P = 0.07$).

Faecal egg counts and worm counts:

Compared to the control the consumption of sainfoin hay was associated with a significant reduction of the adult *H. contortus* burden by 47 % ($P < 0.05$) whereas no significant difference was seen when feeding sainfoin silage (49 %; $P = 0.112$). The *C. curticei* worm burden was not significantly reduced by either sainfoin hay or silage.

At the termination of the experiment FEC were significantly reduced by sainfoin hay by 64 % ($P < 0.001$) compared to the control feed. After feeding sainfoin silage FEC decreased by 48 % ($P = 0.056$). For more details on parasitological results see HECKENDORN et al. (2006).

The main finding of this experiment is that by feeding sainfoin hay for 16 consecutive days, the *H. contortus* burden was significantly reduced by 47 % compared to respective control group. This level of reduction is considerably higher than observed in previous studies using CTs, although a direct comparison is not possible due to experimental design and source of CTs. When feeding sainfoin silage, adult worm counts decreased by 49 % compared to the control. However, this result was not significant, possibly due to the lack of statistical power of the test. The substantial decrease of FEC is important with respect to reduction of pasture contamination with infective larvae developing from the eggs. Animals consuming sainfoin hay in our experiment exhibited higher daily weight gains compared to the controls. It is suggested that this finding is associated with the significantly lower *Haemonchus* worm burden observed in this group compared to the respective control group.

Conclusion:

To our knowledge this is the first study looking at the effect of conserved sainfoin on sheep gastrointestinal nematodes (GIN). Concerning sainfoin hay, this experiment presents results pointing to a nematocidal effect towards *H. contortus*. In regions with moderate climatic conditions the production of soil dry sainfoin hay is problematic because the cut plant needs a short and hot drying phase in order not to lose the CT-containing leaves in the drying process. As a feasible conservation alternative, ensiled sainfoin was therefore produced for this experiment. Although CT-contents were slightly lower in sainfoin silage than in hay, the anti-parasitic effect was largely maintained using this conservation procedure. However, no information on the stability of CT-molecules in ensiled tanniferous plants exists. This area needs careful evaluation in view of future implementation of the control strategy. Further studies using sainfoin silage must be performed, in order to determine its effect on other GIN species and to evaluate the acceptance of the strategy among farmers.

Overall, conservation of tanniferous fodder plants offers exciting opportunities with respect to centralized production, sale, storage and an extended administration independent of the season.

Acknowledgements:

The authors are grateful to the Swiss Federal Office for Agriculture (BLW) for financial support and to the Swiss Federal Research Station for Animal Production and Dairy Products (ALP) for carrying out the nutritive analysis. Paul Torgerson from the Institute of Parasitology, University of Zurich helped in statistics and Lucia Kohler aided in worm isolation.

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Beitrag archiviert unter <http://orqprints.org/view/projects/wissenschaftstagung-2007.html>

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