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Short communication

Effects of strategic anthelmintic treatments on the milk production of dairy sheep naturally infected by gastrointestinal strongyles

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Abstract

The present paper was aimed at assessing the benefit of strategic anthelmintic treatments on milk production in four commercial dairy sheep farms in Southern Italy whose animals were naturally infected by gastrointestinal (GI) strongyles and *Dicrocoelium dendriticum*. The scheme was based on two treatments timed in relationship to parturition, i.e. the first with moxidectin in the periparturient period and the second with netobimin at the mid/end of lactation. On each farm, two similar groups (20 animals each) were formed, one untreated control group and one group treated according to the above-mentioned scheme. Faecal egg counts (FEC) were performed on each study animal at the start of the trial and then monthly until the end of the study; in addition, milk production was recorded for each animal fortnightly in each farm for the lactation period. The results showed a significant increase in milk yield across all four farms that ranged from 19% to 44% improvement in milk yield. The benefit in milk yield in addition to considerably reduced egg output of the treated animals provide clear evidence that the two main aims of prophylactic parasite control, i.e. to maintain or improve animal performance and to reduce pasture contamination, can be achieved using strategic anthelmintic treatments.

Keywords: Gastrointestinal strongyles; *Dicrocoelium dendriticum*; Sheep; Strategic anthelmintic treatments; Milk production

1. Introduction

Small ruminant dairying is particularly important to the agricultural economy of the Mediterranean region which produces 66% of the world's sheep milk and 18% of the world's goat milk (Pandya and Ghodke, 2007). However, since parasitic diseases caused by a number of helminth genera such as *Teladorsagia*, *Haemonchus*, *Trichostrongylus* and *Dicrocoelium* can have a major impact on small ruminant production in the region (Manga-González et al., 2001; Hoste et al., 2005; Rinaldi et al., 2007), effective control strategies can offer considerable economic benefits to small ruminant producers (Jordan and Perez, 1991; Cringoli et al., 2007). Control of these parasitic infections in small ruminants relies almost exclusively on dosing with anthelmintics. The strategic and economic benefits deriving from treatment can vary depending upon a number of factors including the timing of treatments;

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however, the maximum economic benefit is often obtained when anthelminthic use is aligned with parasite epidemiology (Ketzis et al., 2006). In this day and age attention also needs to be given to the sustainability of anthelmintic treatment regimes as well as to their immediate economic benefit. The beneficial impact of anthelmintic treatment on milk production have been extensively documented in dairy cows (e.g. Ploeger et al., 1990; Corwin, 1997; Nodtvedt et al., 2002; Forbes et al., 2004); however, few studies have been conducted on the impact in dairy goats (Veneziano et al., 2004) and sheep (Jordan and Perez, 1991; Fthenakis et al., 2005).

The aim of the present paper was to assess the benefit of strategic anthelmintic treatments on milk production in four commercial dairy sheep farms in Southern Italy whose animals were naturally infected by gastrointestinal (GI) strongyles and *Dicrocoelium dendriticum*. The scheme was based on two treatments timed in relationship to parturition, i.e. the first with moxidectin in the periparturient period (during the last month of gestation or soon after lambing during the period when lambs were suckling) and the second with netobimin at the mid/end of lactation.

2. Materials and methods

2.1. Study farms

The study was conducted in a hilly area of Southern Italy, in two contiguous regions, Campania and Molise. The climate is Mediterranean with dry summers and wet winters.

Four commercial sheep farms were used for the study, two in 2006 (farms 1 and 2) and two in 2007 (farms 3 and 4). Table 1 shows the zootechnical characteristics of the studied farms, as well as the prevalence (%) and the faecal egg counts (EPG) of GI strongyles and *D. dendriticum* at the beginning of the study. In all the farms the parturition took place from 10th February to 15th March and the lactation period from parturitions to June/August.

2.2. Treatments

On each farm, two similar groups containing 20 ewes were formed on the basis of breed, age, weight, number of pasturing seasons, and positive GI strongyle EPG. The group treatments were randomly assigned, one group being left untreated to act as a control group and one group treated twice once in the periparturient period (February) with moxidectin (Cydectin™ 0.1%, Fort Dodge Animal Health) *per os* at the dosage of 0.2 mg/kg body weight, and at the mid/end lactation (June) with netobimin (Hapadex™ 5%, Shering-Plough) *per os* at the dosage of 20 mg/kg body weight. Both drugs are licensed for use in sheep in Italy. Their activity against GI strongyles in sheep is well known, netobimin (at the high dosage used) is also effective against *D. dendriticum* (Veneziano et al., 2006).

At each treatment date, the individual sheep were weighed and the dosage of the drug was calculated on the basis of individual body weight. Sheep in the control groups did not receive any treatment but were subjected to the same handling procedures as the sheep of treated groups.

On each farm, sheep of both treated and untreated groups co-grazed on the same pasture throughout the study.

2.3. Coprological examinations

On each farm, individual EPG were determined by using the FLOTAC technique (Cringoli, 2006) with a

Table 1
Zootechnical characteristics and GI strongyle and *D. dendriticum* infection level (% and EPG) of the four studied farms

Farms	Zootechnical characteristics				Infection level prevalence (%) and EPG			
	No. of sheep on farm	Breed	Production type	Pasturing period	GI strongyles		*D. dendriticum*	
					%	EPG	%	EPG
Farm 1	250	Pinzirita and cross-breeds	Dairy	March–November	100	720	100	90
Farm 2	200	Pinzirita and cross-breeds	Mixed	Throughout the year	100	600	100	75
Farm 3	550	Merinizzata Italiana and cross-breeds	Mixed	April–December	100	700	80	16
Farm 4	1500	Gentile di Puglia and cross-breeds	Mixed	Throughout the year[a]	100	270	100	120

[a] With transumance.

sensitivity of 2 EPG, using two flotation media, a sucrose flotation medium (specific gravity-s.g. = 1.250) for the count of GI strongyle eggs and a zinc sulphate plus potassium iodomercurate flotation medium (s.g. = 1.450) for the count of *D. dendriticum* eggs (Cringoli et al., 2004).

Faecal egg counts (FEC) were performed on each study animal at the start of the trial (February, T0) and then monthly until the end of the study (July). In addition, in order to evaluate the efficacy of the drugs, FECs were also performed 14 days after treatment (FEC reduction test).

2.4. Milk production yield measurements

Milk production (ml) was recorded for each animal fortnightly in each farm for the lactation period, from April (soon after the suckling period) to July. Depending upon the different farm management practices milk production was recorded either on both morning and evening (farms 1 and 2) or only on the morning (farm 3) or evening (farm 4). Milk samples were collected into plastic containers. In order to avoid misreading by foam formation, milk samples were then slowly poured into a volumetric glass cylinder graduated to 5 ml and allowed to stand 5–10 min before reading.

2.5. Data analysis

All the statistical analyses were performed using SPSS software (Version 13).

At each faecal sampling time, GI strongyle EPG values were transformed to natural logarithms [ln $(x + 1)$] to calculate their geometric means (GM). The Mann–Whitney U-test was used to compare the mean GI strongyle EPG values from treated and control groups of the four farms at each sampling day. $P < 0.05$ was considered as statistically significant.

A generalized linear model (GLM) repeated measure analysis of the effect of the group (treated *versus* control) on milk production was performed. In particular, milk production (ml) values were introduced into the model as dependent variables, group as categorical fixed factor, and differences (days) between milk sampling date and parturition date as covariates.

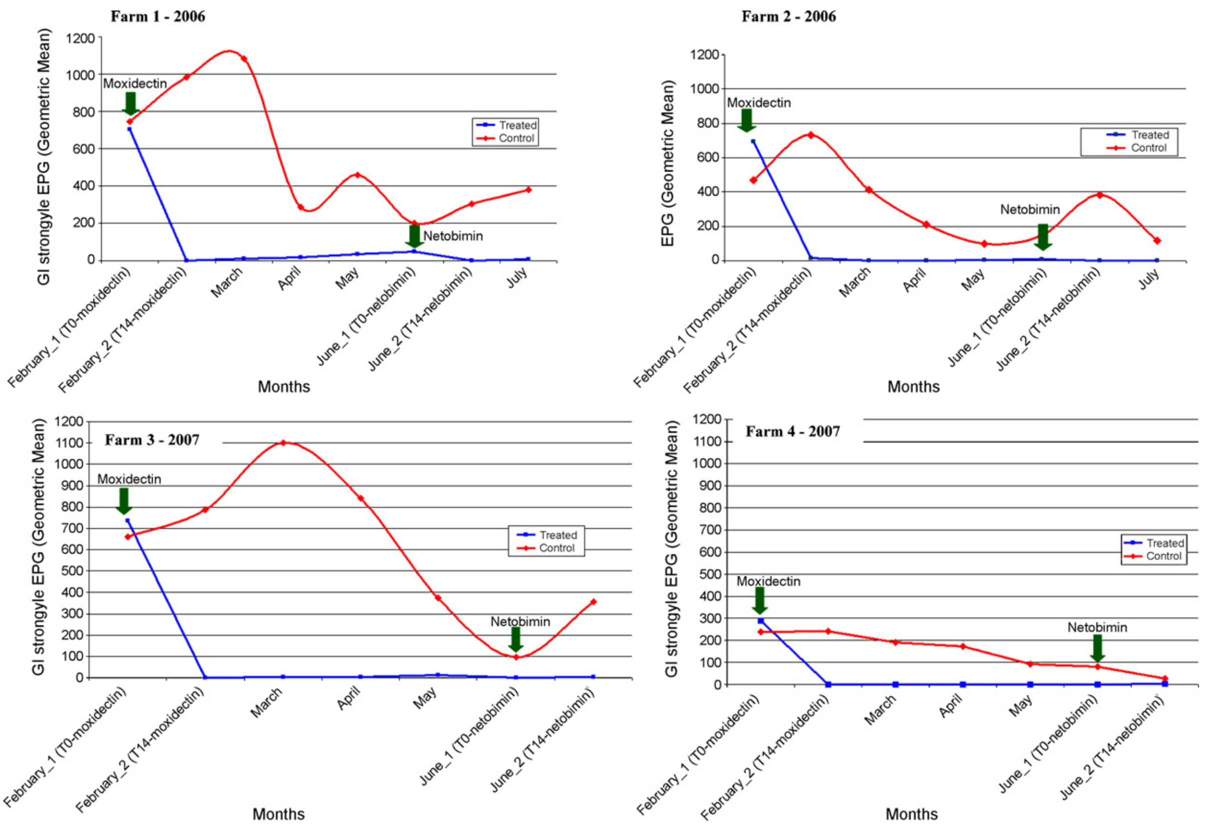

Fig. 1. GI strongyle faecal egg counts (geometric mean EPG) in the groups treated with the strategic anthelmintic scheme compared with the control untreated groups in the four studied farms.

Estimated marginal means of milk production at each sampling time were calculated.

3. Results

3.1. Coprological examinations

In all the four farms, the distribution of GI strongyle EPGs at T0 did not differ significantly among control and treated groups. At T14, the efficacy of moxidectin was 100% on farms 1, 3 and 4, and 97.1% on farm 2; whereas the efficacy of netobimin was 100% in all the four studied farms. In addition, treated animals on the four farms had GI strongyle egg counts that were significantly lower ($P < 0.05$) than their control counterparts throughout the study (Fig. 1). Following the second treatment in June with netobimin the level of *D. dendriticum* infection decreased in the treated groups of all the four farms (data not shown).

3.2. Milk yield

Estimated marginal means of milk yield production for the control and treated groups in the four farms on each date are shown in Fig. 2. At each milk sampling date, the treated groups of each farm had milk yields that were higher than their control groups and on some occasions these differences were significant. Overall, the mean daily milk production of the treated groups were significantly ($P < 0.001$) higher than those of the control groups as follows: 881.8 ml *versus* 741.4 ml (+18.9%) in farm 1; 348.4 ml *versus* 267.2 ml (+30.4%) in farm 2; 229.4 ml *versus* 167.4 ml (+37.0%) in farm 3; and 382.4 *versus* 265.1 (+44.2%) in farm 4.

4. Discussion

For producers the two primary aims of prophylactic antiparasitic treatment strategies are, in the face of ongoing parasite challenge, firstly to maintain or

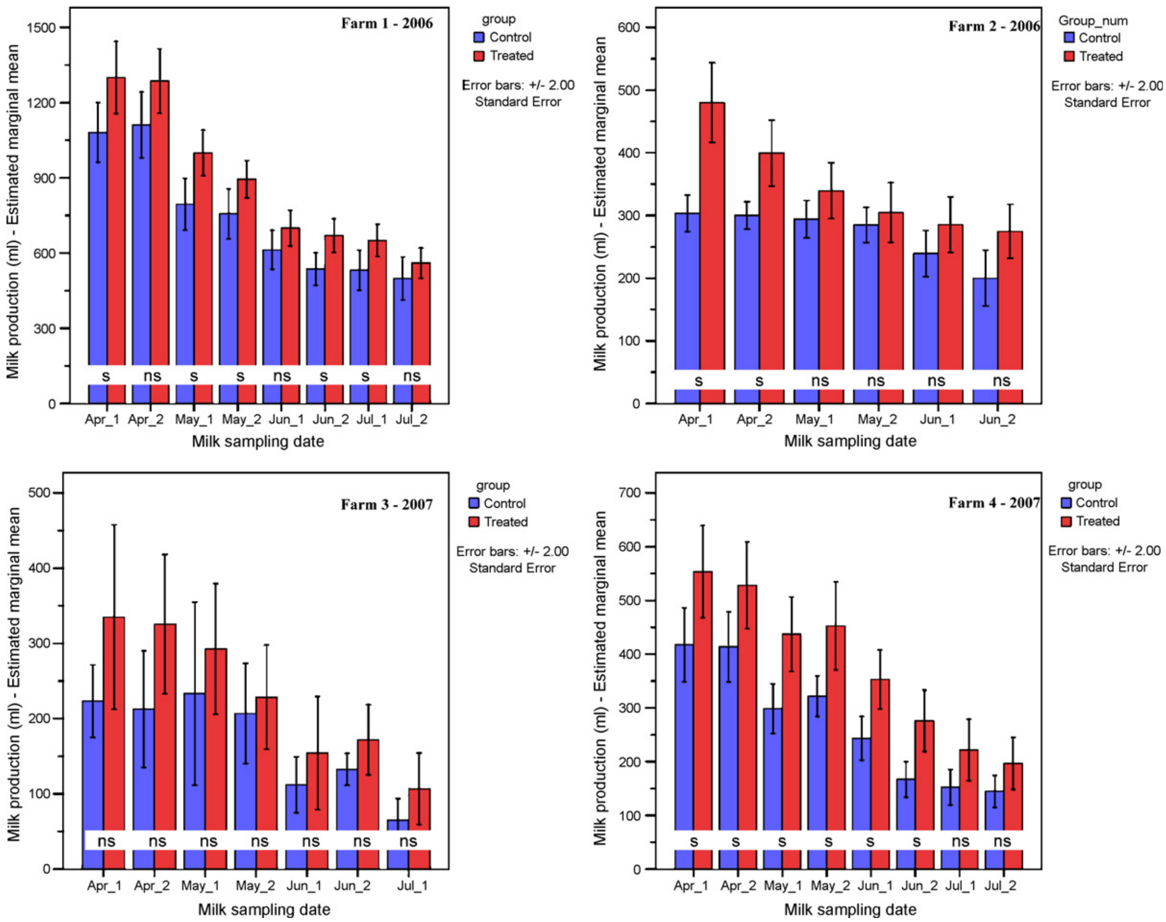

Fig. 2. Estimated marginal means by GLM of milk production (ml) in the four studied farms. Legend: s: significant; ns: not significant.

improve animal performance and secondly to reduce pasture contamination. The improvements in milk yield in addition to considerably reduced egg output of the treated animals in the current study provide clear evidence that the anthelmintic treatment regime in dairy sheep in the region was strategically and economically effective.

Treatment with moxidectin during the periparturient period caused a consistent increase in milk yield across all four farms and all sampling times that resulted in an overall 19–44% greater milk yield. These results are in general agreement with studies in dairy sheep (Restani, 1965; Fthenakis et al., 2005) that have used lamb liveweights to provide an indirect measure of milk production, and have reported milk yield to be increased by 15% following anthelmintic treatment with moxidectin towards the end of the gestation. The magnitude of the increase in milk production in the current study is perhaps surprising as the cross-contamination as a result of the co-grazing of both treated and untreated groups would be expected to limit the epidemiological advantage of treatment to the period of persistent activity of the chemical, which should not have been greater than 5 weeks. Previous studies in small ruminant dairy animals have shown that GI strongyle and *D. dendriticum* infections act to reduce the availability of nutrients that are likely to be partitioned for milk production (Jordan and Perez, 1991; Hoste and Chartier, 1993; Veneziano et al., 2004). Although nutrient supply was not monitored in the current study, it is possible that the observed increase in milk yield in treated animals may have been as a consequence of a greater nutrient supply due to reduced helminth infection. It may be possible that a greater nutrient supply that was afforded the treated animals during the persistent period of moxidectin, i.e. first few weeks of lactation, was sufficient to pre-programme a greater level of milk production for the remainder of the lactation interval. It is apparent that further elucidation of the mechanisms involved may provide a useful means of streamlining anthelmintic usage even further.

Treatment with moxidectin at the periparturient stage appeared to assist the ability of the host to limit egg excretion. Given the likely contamination from co-grazing with their untreated counterparts, it would be expected for GI strongyle eggs to be appearing in the faeces by 8 weeks post-treatment (April). However, even by the time of the second treatment with netobimin at week 16 post-treatment, there were very few GI strongyle eggs present in the faeces. It seems unlikely that this simply reflects seasonal variation in parasite challenge, as it may be expected that there would still be considerable numbers of infective larvae on pasture during the months of April and May. Alternatively, it may be speculated that the periparturient treatment provided a sufficient period of protection to allow the re-establishment of their immunity. Support for this can be drawn from the timings of the reduction in FEC in non-treated animals during the months of April and May that are presumably due to the re-establishment of immunity. Whether the anthelmintic treatment assisted in the re-establishment of immunity through the provision of a greater nutrient supply, as mentioned for milk production above, remains a point of interest for further research.

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