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Frequency of eprinomectin resistance in gastrointestinal nematodes of goats in canton Berne, Switzerland

Sarah Murri[a,d], Gabriela Knubben-Schweizer[b], Paul Torgerson[c], Hubertus Hertzberg[d,*]

[a] Ambulatory Clinic and Herd Management Unit, Vetsuisse Faculty, University of Zurich, Winterthurerstrasse 260, 8057 Zurich, Switzerland
[b] Clinic for Ruminants with Ambulatory and Herd Health Services at the Centre for Clinical Veterinary Medicine, Ludwig-Maximilians-University Munich, Sonnenstrasse 16, 85764 Oberschleissheim, Germany
[c] Section of Epidemiology, Vetsuisse Faculty, University of Zurich, Winterthurerstrasse 270, 8057 Zurich, Switzerland
[d] Institute of Parasitology, Vetsuisse Faculty, University of Zurich, Winterthurerstrasse 266a, 8057 Zurich, Switzerland

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ABSTRACT

Eprinomectin (EPN) is a member of the avermectin class of compounds and the only anthelmintic registered for goats in Switzerland with a zero milk withdrawal period. The aim of the present study was to identify the actual efficacy of EPN in an area with a higher density of goat enterprises. Forty-three randomly chosen farms from canton Berne were investigated. At least eight goats were investigated on every farm. Conditions for inclusion in the study were the absence of anthelmintic treatment during the previous six weeks and a pooled faecal sample showing a mean faecal egg count (FEC) higher than 600 epg faeces. Pre- and 14–16 days post-treatment samples were individually collected directly from the rectum. Animals were treated with the recommended dose of EPN (1 mg/kg body weight) after taking the pre-treatment samples. Efficacy of EPN was tested with the faecal egg count reduction test (FECRT) and faecal cultures were performed on every farm from pooled faeces samples before and after treatment. Additionally the farmers completed a questionnaire. None of the gastrointestinal nematode populations of the 43 investigated farms were susceptible to EPN at the required level. The mean egg count reduction was 40%. None of the typical risk factors, such as production type, stocking rate, animal traffic and quarantine measures showed an association with the level of eprinomectin resistance. It can be concluded with 80% certainty that the prevalence of EPN resistance on goat farms is at least 95% in canton Berne.

1. Introduction

Anthelmintic resistance of gastrointestinal nematodes (GIN) has become a globally important issue for the goat and sheep industry (reviewed by Kaplan, 2004; Jabbar et al., 2006). In Switzerland benzimidazole resistance is widespread in GIN of small ruminants (Hertzberg et al., 2000). After the detection of the first case of avermectin (AVM) resistance in goats in Switzerland (Schnyder et al., 2005), a further study, focussing on Boer goats and Dorper sheep showed that AVM resistance seems to be widespread in GIN of these breeds (Artho et al., 2007).

Eprinomectin (EPN) is a member of the avermectin class of compounds and the only anthelmintic registered for

* Corresponding author. Tel.: +41 44 635 85 16; fax: +41 44 635 89 07.
E-mail address: hubertus.hertzberg@access.uzh.ch (H. Hertzberg).

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goats in Switzerland with a zero milk withdrawal period, making it desirable in lactating animals (Dupuy et al., 2001). Targeted selective treatment (TST) is seen as an important development to slow down the development of anthelmintic resistance (reviewed by Kenyon et al., 2009). Integrated in a larger study on the implementation of the TST-approach, the present study identified the efficacy of EPN in an area with a high density of goat enterprises. Canton Berne, representing the Swiss midland, as well as the (pre-)alpine region was chosen as study region, as approximately 25% of the total Swiss goat farms (7190) are located in that area.

2. Materials and methods

Farms in canton Berne with at least eight goats were randomly contacted by phone. Addresses were provided by the extension and health service for small ruminants (ESSR). Conditions for inclusion in the study were the absence of anthelmintic treatment during the previous six weeks and a mean faecal egg count (FEC) higher than 600 epg faeces. This was determined by a pooled faecal sample provided by the owners. Owners were asked to complete a questionnaire including general farm management, housing systems, animal movements, worm control practices and anthelmintic usage. Pre- and 14–16 days post-treatment samples were individually collected directly from the rectum. Pre-treatment faecal samples were collected from eight animals and post-treatment samples were taken from the six animals with the highest pre-treatment FECs. Because of Poisson errors removing these low counts improves the accuracy of the FECRT. For example, Coles et al. (2006) recommend removing all counts of less than 150 epg from the analysis. Animals were treated with the recommended dose of eprinomectin pour-on solution (1 mg/kg body weight, Eprinex® Pour-On, Biokema). The anthelmintic was administered with the commercially available applicator along the dorsal line, from the withers to the tail head, parting the coat to obtain direct contact with the skin. To avoid underdosing, body weight was visually estimated for every goat individually by two experienced persons, and then an additional 20% of the estimation was added to calculate the individual administered dose. Strongyle nematode FECs were determined with a sensitivity of 50 epg using the modified McMaster technique according to Schmidt (1971).

Efficacy of EPN was tested with the FECRT, based on the recommendations of the World Association for the Advancement of Veterinary Parasitology (Coles et al., 1992; reviewed by Coles et al., 2006), but using the statistical analysis of the faecal egg counts according to Torgerson et al. (2005). Due to the generally small flock size, instead of including a control group the mean FECs before and 14–16 days post-treatment were compared.

Faecal cultures (Eckert, 1960) were performed on every farm from pooled faeces samples before and after treatment, using 4 g faeces from each animal. 100 third stage larvae (L3) were differentiated according to MAFF (1986) and Levine (1968) at 400× magnification to determine the genera present.

Relationships between the farm specific parameters and the resistance level (based on the FECR values) were tested for significance using a generalised linear model with a negative binomial distribution assumed for the egg counts. The significance level was determined at $p = 0.05$. All calculations were undertaken in R (R Development Core Team, 2013), using the MASS package (Venables and Ripley, 2002).

3. Results

Based on the detected resistance status the survey was terminated after investigation of 43 farms, sampled from August 2011 to November 2012. A total of 258 goats were included in the study. The investigated farms had a flock size between eight and 67 animals and were located in all parts of the canton (Fig. 1) at altitudes between 400 and 1300 metres above sea level. The Saanen and Chamoisee were the most frequent breeds (21% and 14% respectively); in many cases more than one breed per farm were kept (37%).

The reduction of the mean faecal egg count after treatment was less than 95% on any of the investigated farms (Table 1). In two farms the reduction was between 90 and 93% with lower confidence intervals below 90%. Thirty-nine farms (91%) showed reductions lower than 90%. The mean level of egg count reduction was 40%. Thus it was concluded that there was an 80% certainty for the presence of anthelmintic resistant GIN on at least 95% of goat farms in canton Berne.

Differentiation of third-stage-larvae in the pre-treatment larval cultures demonstrated that *Haemonchus contortus* is the predominant species on 33 farms (77%). *Trichostrongylus* spp. and *Teladorsagia* spp. were dominant on eight and one farm(s) respectively. For one farm (no. 25) evaluation was not possible due to immature larvae. In post-treatment larval cultures, *H. contortus* was the dominant resistant species on 41 (95%) farms. In two cases *Trichostrongylus* spp. was dominant. In addition small proportions of resistant *Teladorsagia* spp. were detected in 18 farms.

In 35 out of 43 farms (81%) goats were kept for milk production and in eight farms (19%) for meat production and breeding purposes. No significant difference was found between milk-producing and non-milk-producing farms with respect to the level of anthelmintic resistance. On all farms, goats had regular access to pasture, but duration of grazing was highly variable. There was no evidence of an association between reported stocking rate and the degree of resistance. Cattle were kept on 25 of the 43 farms (58%), but only 13 farms (30%) kept their goats at least partially on the same pastures as cattle. Sharing pastures with cattle was not associated with the level of resistance. In 12 of 43 farms (28%) all goats (16%) or part of the flock (12%) were grazed alone or with goats from up to six other farms on alpine pastures during the summer. There was no association between transhumance and the level of eprinomectin resistance. Four of 43 farmers (9%) stated that they undertook quarantine measures when integrating new animals into their flocks. Forty-four percent of the farmers answered that parasitic infection represent a