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Effects of gastrointestinal infections caused by nematodes on milk production in goats in a mountain ecosystem: Comparison between a cosmopolite and a local breed

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ABSTRACT

Alpine goats, a cosmopolite breed, and Nera di Verzasca, an autochthonous breed, reared in a mountain ecosystem of Lombardy, northern Italy, were tested for the effect of gastrointestinal nematode-sustained natural infections on both yield and quality of their milk. The survey was based on to the hypothesis that high levels of gastrointestinal nematode infection might affect milk yield, milk quality and lactation period length, and that the animal breed might influence such an effects. Seventy-one adult goats reared in the same farm were used in the study. From February to September 2010, 37 Alpine and 34 Nera di Verzasca goats were sampled for milk and feces monthly. Milk quantity, fat and protein contents, and somatic cell counts (SCC) were determined. The gastrointestinal parasitic infections were evaluated by fecal egg count (EPG) and animals were ranked into five classes according to their mean EPG: Le0 (Level0): <100 EPG; Le1 (Level1): 101–200 EPG; Le2 (Level2): 201–600 EPG; Le3 (Level3): 601–1500 EPG; Le4 (Level4): >1500 EPG. EPG counts and infection prevalence showed a high variability in both breeds, however the mean EPG values in Alpine goats were higher more than twice in comparison with Nera di Verzasca. Milk yield decreased in both breeds as the infection level increased. It occurred when Alpine goats reached level 3 of EPG counts while no decrease was found in Nera di Verzasca goats before reaching EPG level 4. Protein and fat contents were influenced by breed, level of EPG and milking days. Nematode infection was found to affect SCC values only at greatest levels of EPG counts. The results supported a different host–parasite relationship in the two goat breeds. In fact, though a reduction in milk yield, protein and fat contents was observed in both breeds, Alpine goats were found to be weaker in contrasting the effects of gastrointestinal nematodes than the more resilient Nera di Verzasca. The results of this survey can contribute to develop proper strategies in controlling goat parasitism by exploiting resilient breeds and improving sustainable rearing of local breeds.

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1. Introduction

Gastrointestinal nematode (GIN) infections are common in grazing ruminants worldwide and still are one of the main constraints to ruminant production, because they can depress food intake, causing tissue damage and reduction in skeletal growth and live-weight gain as well as decrease in milk yield (van Houtert and Sykes, 1996; Waller, 1997). In dairy goats receiving an anthelmintic treatment, a significant increase of milk yield (+ 12%), fat (+29.9%), protein (+23.3%) and lactose (+19.6%) was observed (Rinaldi et al., 2007). Moreover, a strong interaction between parasite challenge and lactation was clearly proven: For istance, epidemiological studies in French dairy goat flocks showed that both animals in their first lactation and high milk-producing multiparous animals had the greatest fecal egg counts (FEC) (Hoste et al., 2002). Additionally, during the lactation period, a high level of milk production can influence an effective response against parasites, which does not occur in dry goats (Etter et al., 2000). In a previous survey, we studied the effects of GIN on milk production in three goat breeds from different farms. We found that their milk yield was affected by parasite burden, breed and lactation number (Alberti et al., 2012). Moreover, Nera di Verzasca goats, an autochthonous breed, seemed to be characterized by a higher resilience to GIN than the other investigated breeds (Saanen and Alpine), showing minor effects of GIN on their productivity (Alberti et al., 2012). The aim of the present study was to test the effect of differing levels of GIN natural infection on milk yield and quality. We hypothesized that high levels of GIN infection might affect milk yield, milk quality and the length of the lactation period, and that the two goat breeds under investigation – Alpine, a high producing breed (average milk yields 582 kg in 210 days in milk, DIM) and Nera di Verzasca, an unselected breed (average milk yields 358 kg in 180 DIM) – might in turn influence GIN infection.

2. Material and methods

All animal procedures used in this study were approved by the Milan University Institutional Animal Care and Use Committee.

2.1. Farm and animals

The study was carried out on 71 adult female goats (aged 1–≥7 years) from two different dairy breeds: 34 Nera di Verzasca goats and 37 Alpine goats. Animals were reared in the same farm, the two breeds were well integrated and there were no difference in management procedures. The farm was located in northern Italy at 980 m a.s.l on the mountains surrounding Lake Maggiore (46,0715° N, 8,7998° E). Goats were reared in a semi-extensive system, kept in the fold during winter before the kidding period and fed with hay ad libitum and supplemented with an increasing concentrate ration on the basis of the physiological state of the doe (from 300 g/day before kidding to 600 g/day in the early lactating period). Kidding occurred from January to March. Goats were milked twice daily (morning and evening) from kidding to September. From March to November, goats grazed and browsed in a large mountain area (~200 ha) from 900 to 1550 m a.s.l. during the day (or the night in the warmest months) and were kept in the fold during the night (or the day in the warmest months). The area was mainly characterized by the three following climax plant associations: *Quercum-Betuletum insubricum*, *Luzulo niveae-Fagetum*, *Alnetum viridis*. Other associations of the area (*Molinietum*, *Sarothamnetum scopariae*, *Vaccinio-Rhododendretum*) were to be considered as temporary stages leading to one of the above-mentioned main associations (Zanatta, 1996). In this context, goats preferred spending their time eating mainly *Molinia arundinacea* (27.8%), *Betula pendula* (22.9%), *Sarothamnus scoparius* (20%), *Vaccinium myrtillus* (10.9%), *Alnus viridis* (8.2%) and other species (10.2%) (Maggioni et al., 2004)

2.2. Samples and techniques

An anthelmintic treatment (netobimin 15 mg/kg b.w.) was administered to the whole herd in December 2009. Individual fecal samples were collected both on day 0 and on day 10 post-treatment from dosed goats to assess the efficacy of the treatment and to exclude the presence of anthelmintic resistance in the flock,. Fecal egg count reduction (FECR) calculated by Cabaret and Berrag formula (2004), had values comprises between ≥95% and 100% showing the efficacy of the treatment.

From February to September 2010, individual milk yield daily tests (ICAR, 2009, AT4 method) were collected monthly at the official Milk Recording. Qualitative and quantitative milk parameters were evaluated by the Milk Standard Laboratory of A.I.A, an Italian Breeder Association. Milk quantity (liter, l), fat (percentage, %) and protein (percentage, %) were assessed following the routine infrared method (Laboratorio Standard Latte – Associazione Italiana Allevatori; LSL–AIA http://www.aia.it/lsl/index.htm). Somatic cell counts (SCC, 10^3/ml) were determined by fluoro-opto-electronic counting (Bentley SOMACOUNT 150, Bentley Instruments, USA).

Individual fecal samples were collected monthly from the rectum during the lactating period (±7 days from the day of milk collection) and in January, October and November to evaluate the GIN infection throughout EPG counts. A total of 716 fecal egg counts were carried out by FLOTAC *double technique* with NaCl as flotation solution (specific gravity 1.200) (sensitivity 1 egg/g of feces) (Cringoli et al., 2010).

2.3. Statistical analysis

Chi-square test for goodness of fit to a negative binomial distribution was applied to EPG counts (SPSS software vers.17.1). Prevalence values were calculated according to Bush et al., 1997. EPG, daily milk, protein and fat values and SCS were analyzed separately as repeated measures according to a randomized complete block design using the PROC MIXED procedure of SAS (SAS Institute Inc. 2008. SAS OnlineDoc® 9.1.3. Cary, NC). All data were analyzed using a first-order autoregressive covariance structure.

The model for EPG was: $y_{ijklm} = \mu + B_i + KM_j + BAG_{ik} + b_1 DIM_{ijklm} + b_2 DIM^2{}_{ijklm} + b_3 DIM^3{}_{ijklm} + A_l + e_{ijklm}$