Dynamics of gastrointestinal parasitoses in goats kept in organic and conventional production systems in Brazil

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**Abstract**

The objectives of this paper were to analyze the dynamics of gastrointestinal helminthiasis in Saanen goats maintained in organic and conventional milk production systems during pregnancy, parturition and lactation. In the conventional system, the animals were kept under continuous grazing and dewormed monthly. In the organic system, no anthelminthics were used, the animals were kept under rotational grazing and separated by age. The goats in the organic system had higher fecal egg counts \((p < 0.05)\) than the goats in the conventional system during pregnancy and parturition, with no statistical difference \((p > 0.05)\) during lactation. The peripartum period was a risk factor for the occurrence of clinical parasitism in animals with a greater predisposition in the herd, thereby increasing the infestation of pastures. In the conventional system, even with monthly deworming, the animals were moderately infected, thus demonstrating the possibility that helminth resistance or high reinfection rates might develop. Although no anthelminthics were used in the animals raised in the organic system, they showed a moderate degree of infection, thus indicating that management might be present a viable option for sustained helminth control.

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1. Introduction

The growth of markets increasingly interested in products with no chemicals has encouraged producers in agro-exporting countries to adopt organic production systems. In Brazil, the demand for organic products has been growing by 10% a year, which reflects consumers’ desire to buy milk from animals raised in systems that promote animal welfare and are sustainable and environmentally friendly (D’Almeida, 2005). Despite great potential for developing organic products of animal origin, Brazil’s organic production is still at an initial stage, not even reaching 0.1% of national demand (Aroeira and Fernandes, 2001). A variety of factors contribute towards this low production level, such as the lack of research focusing on animal diets, breeding and healthcare, especially with regard to gastrointestinal helminth infections (Nardone et al., 2004; Larsson et al., 2007).

For there to be rational and sustainable control of gastrointestinal helminths in animals kept in organic production systems, knowledge of the risk factors associated with parasite epidemiology, pasture management, animal nutrition and animal breeding is required (Larsen, 2002). The fight against helminths in tropical countries has mainly been conducted through uncontrolled use of anthelminthic compounds (Nansen, 1993). Although these drugs have been shown to have proven efficacy, the lack of protocol for their use in tropical regions, coupled with their disorderly use, has led to increasing production costs. In addition, the way in which these drugs have been used has contributed towards the emergence of resistant strains (Amarante et al., 2004) and consumers have raised concerns about residue levels in foods of animal origin (Coop and Kyriazakis, 2001).
The effects of gastrointestinal nematodes in dairy goats are greatest during the period preceding parturition and during the first of lactation. It is known that during this period, which is known as the peripartum, the phenomenon of periparturient relaxation of immunity occurs. In this, the animals become more susceptible, thus making them vulnerable to parasites (Barger, 1993). Periparturient relaxation of immunity to nematodes, and its consequences on the epidemiology of parasitic infection, have been extensively studied in sheep (Mahieu and Aumont, 2007; Beasley et al., 2010). Data on periparturient relaxation of immunity in dairy goats is quite scarce in tropical countries (Gibbs, 1986).

Armour (1980) found that close to parturition, there was a decrease in host immunity, characterized by high fecal egg count (FEC) values. In the present study, the increase in FEC values during the peripartum period was attributed the recent intake of larvae from pasture feed, together with possible immunosuppression among the animals. These two factors may provide a suitable environment for prolificacy of adult helminths in the gastrointestinal tract of the animals and reduce their defenses against reinfection.

Thus, this study aimed to ascertain the frequencies of gastrointestinal helminths in Saanen goats (Capra hircus) maintained in organic and conventional milk production systems during pregnancy, parturition and lactation.

2. Materials and methods

The experimental activities were conducted in November 2007 to August 2008, in the goat sector of the Technical College, Federal Rural University of Rio de Janeiro (UFRRJ) and in the goat sector of the Zootech-nics Institute, UFRRJ, both located in the municipality of Seropédica, state of Rio de Janeiro, Brazil. According to the Köppen climate classification (Köppen and Geiger, 1928), the climate of the region belongs to the Aw class, characterized by dry and rather pronounced winters, warm and rainy summers, annual rainfall of 1300 mm, average annual temperature of 24 °C and relative humidity of 70%.

The study design was completely randomized. The first treatment consisted of 26 pregnant goats kept in an organic production system. The second treatment consisted of 30 pregnant goats kept in a conventional production system. All animals were of the Saanen breed, aged between 2 and 4 years and suffering from natural infection.

The parasite control performed on the animals kept in the organic production system was mainly based on rotational grazing, separation of animals by class and according to age, adequate nutrition and supply of hay and silage. The animals were divided into three groups according to age. The first group consisted for animals of 0–6 months, the second for animals of 7–12 months and the third for animals older than one year. All animals kept in this system were supplemented during the dry season of the year (April–September) with corn silage (Zea mays) and Tifton hay (Cynodon dactylon) supplied daily ad libitum.

In the conventional system, anthelminthic prophylaxis was administered once a month. The active ingredients used were moxidectin (0.2 mg/kg, Cydectin®), Fort Dodge, Brazil), levamisole phosphate (10 mg/kg, Ripercol® L 150 F, Fort Dodge, Brazil) and albendazole (10 mg/kg, Valbazen® 10 Cobalto, Pfizer, Brazil). Monthly anthelminthic rotation was used, with a different active principle employed in each month.

In the organic system, the animals were kept in six paddocks, each with an area of 1.5 ha. The grazing method used was rotational, with five days of grazing, 30 days of rest and a stocking rate of 20 AU/ha. The pasture was composed of Brachiaria humidicola. In the conventional production system, the animals were kept under continuous grazing and the area used was 2 ha, with a stocking rate of 10 AU/ha. The pasture was composed of B. humidicola. In both systems, the animals were fed during the dry season of the year with elephant grass (Pennisetum purpureum cv. Cameroon) and sugar cane (Saccharum spp.), which were chopped and placed in troughs, and mineral salt ad libitum.

Fecal samples were collected fortnightly from all goats during the five months of pregnancy, one month of parturition and four months of lactation, except during the nine weeks postpartum when samples were collected at seven-day intervals. The numbers of gastrointestinal nematode eggs per gram of feces (EPC), from nematodes of the Trichostrongyloidea and Strongyloidea superfamilies, were counted using the McMaster technique, as described by Gordon and Whitlock (1939).

**Fig. 1.** Average and standard error of the fecal egg count (FEC) values among Saanen goats maintained in the organic and conventional production systems during the five months of pregnancy, parturition (sixth month) and four months of lactation, Federal Rural University of Rio de Janeiro (UFRRJ), November 2007 to August 2008.
was no significant difference ($p < 0.05$) between the two production systems. The results demonstrate that the organic system besides being environmentally friendly is also economically viable.

### 3. Results

The monthly average fecal egg count values from the goats kept in the organic and conventional production systems during the pregnancy, parturition and lactation periods are shown in [Fig. 1](#).

The animals kept in the organic production system had higher FEC values ($p < 0.05$) than the animals in the conventional system during the five months of pregnancy and in the month of birth (month of parturition). Although the animals kept in the conventional system had shown higher FEC values than the animals kept in the organic system during the lactation period, there was no significant difference ($p > 0.05$).

The mean values and standard deviations relating to the FEC values of animals kept in the organic and conventional systems during the prepartum, parturition and postpartum periods are shown in [Table 1](#). Analysis of the results within groups showed that the mean FEC values at parturition was significantly higher ($p < 0.05$) than in the prepartum and postpartum periods. On the other hand, comparison of FEC values between the prepartum and postpartum periods showed that they were significantly lower during the prepartum period ($p < 0.05$) only among animals raised using the conventional system.

The results from coprological cultures demonstrated that *Haemonchus* was predominant (70%), followed by *Trichostrongylus* (28%) and *Oesophagostomum* (2%). There was no significant difference ($p < 0.05$) between the helminth populations in the two groups.

Although the aim of this study was not evaluate productive and reproductive parameters, some observations are worth mentioning. In the conventional system there was a miscarriage rate of 6.5% (2/30) whereas in organic system no abortion was diagnosed (0/28). The mortality rate at weaning in the conventional system was 10% (3/30) and in the organic system was 3.6% (1/28). The number of twin pregnancies, birth weight and weaning did not differ significantly ($p < 0.05$) between the two production systems. These results demonstrate that the organic system besides being environmentally friendly is also economically viable.

### 4. Discussion

In the conventional system, the animals showed degrees of infection ranging from mild to moderate, according to the pathogenicity scale described by Ueno and Gonçalves (1998). This was probably due to the prophylactic use of anthelmintics. However, the values were higher than expected, thus suggesting the possibility of application error (such as underdosing), high reinfection rates or development of resistance to the anthelmintic active ingredient (Sczesny-Moraes et al., 2010).

Although the animals kept in the organic system had higher FEC values than the animals kept in the conventional system, over the entire study period, the results were satisfactory. Since the organic system was self-sustaining, environmentally correct and animal welfare-promoting, the parasite load was considered tolerable and compatible with the production model. The high fecal egg counts were expected, since in tropical and subtropical areas, the degree of gastrointestinal parasitism is very high, especially in genetically improved animals used for milk production, like the Saanen (Amarante et al., 2004).

The FEC values of the animals in the organic production system remained low, probably because of the good management practices used. The results from this study corroborate the findings of Höglund et al. (2001) and Larsson et al. (2007), who observed in their studies that supplementation of pasture feed and separation by age led to a significant reduction in fecal egg counts, even without the use of anthelmintics.

The current results corroborate earlier studies (Chartier et al., 2000; Mello and Coutinho, 2004) in which significant increases ($p < 0.05$) in fecal egg count occurred during the peripartum period. Kahn (2003) proposed that this increase in peripartum average FEC values was induced by variation in the immune response to parasites, during late pregnancy and early lactation. In the present study the increase in FEC values was probably due to a higher fecundity of the established adult populations (Flemming, 1997), an increased establishment of ingested larvae or a resumption of development by inhibited larvae (Gibbs, 1986).

The predominance of *Haemonchus* is worrisome given that this infection can cause severe anemia and hypoproteinemia, according to Faria et al. (2002), and depression, loss of body condition, reduced productivity and possibly death (Kaplan et al., 2004). Perry et al. (2002) concluded that *Haemonchus contortus* was singly the most important of all the gastrointestinal nematodes that constrain the survival and productivity of goats owned by the rural poor in the developing world. This haematophagous parasite is infamous throughout the humid tropics/subtropics, being responsible for acute disease outbreaks with high level

### Table 1

Average values and standard deviations of egg per gram (EPG) counts among Saanen goats maintained in the organic and conventional production systems during the pregnancy, parturition and postpartum phases, Federal Rural University of Rio de Janeiro (UFRRJ), 2007–2008.

<table>
<thead>
<tr>
<th>Systems</th>
<th>Prepartum</th>
<th>Parturition</th>
<th>Post partum</th>
</tr>
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<tbody>
<tr>
<td>Organic</td>
<td>740 ± 113&lt;sup&gt;Ax&lt;/sup&gt;</td>
<td>1300 ± 256&lt;sup&gt;Ay&lt;/sup&gt;</td>
<td>837 ± 148&lt;sup&gt;Ax&lt;/sup&gt;</td>
</tr>
<tr>
<td>Conventional</td>
<td>520 ± 214&lt;sup&gt;Ab&lt;/sup&gt;</td>
<td>1050 ± 364&lt;sup&gt;Bb&lt;/sup&gt;</td>
<td>912 ± 85&lt;sup&gt;Ac&lt;/sup&gt;</td>
</tr>
<tr>
<td>Average</td>
<td>614 ± 206</td>
<td>1175 ± 298</td>
<td>875 ± 134</td>
</tr>
</tbody>
</table>

Averages followed by different uppercase letters in the columns and lowercase letters in the rows were statistically different according to the nonparametric Kruskal–Wallis and Wilcoxon tests at the 5% probability level, respectively.

To recover and identify infective larvae from the feces, the coproculture technique as modified and described by Ueno and Gonçalves (1998) was used.

For quantitative analysis of the different parameters studied, analysis of variance (ANOVA), linear regression and Student’s $t$ test were used, at the significance level of 5%. The data obtained were computed and stored in a data base set up using the Epi Info<sup>®</sup>, version 3.5 statistical software (Centers for disease control and prevention, Brazil, 2008).

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of mortalities, particularly in young animals (Krecek and Waller, 2006).

5. Conclusion

The management practices adopted in the organic production system were efficient for controlling helminthiasis. In contrast, monthly applications of anthelmintics were not efficient in combating helminths. Further studies are needed to investigate the possibility that nematode resistance might have occurred with drugs used.

The peripartum period was a risk factor for occurrence of clinical parasitism in the animals, thereby increasing the infestation of pastures.

Conflict of interest

None of the authors (J.B. Silva, G.M. Fagundes and A.H. Fonseca) has a financial or personal relationship with other people or organisations that could inappropriately influence or bias the paper entitled “Dynamics of Gastrointestinal Parasitoses in Goats Kept in Organic and Conventional Production Systems in Brazil”.

References


