Parasitic Infections of West African Dwarf Goats and their Saanen Crosses in a Zero-Grazing Farming System in The Gambia

S. Dhollander[1*] S. Kora[1] M. Sanneh[1] M. Gaye[1]
S. Leak[1] D. Berkvens[2] S. Geerts[2]

Keywords

Goat – Dwarf goat – Crossbreeding – Helminth – Coccidiosis – Trypanosomosis – Zero-grazing – Gambia – West Africa.

Summary

Twenty West African Dwarf goats (WADs) and 15 Saanen x WAD crosses were managed in an intensified, zero-grazing farming system in an area with low to moderate tsetse challenge in The Gambia. During a period of one year, monthly samples were collected to monitor the helminth egg (EPG) and coccidia oocyst outputs (OPG) per gram of feces, the packed cell volume (PCV), and trypanosome parasitemia in the goats. High OPGs were found from September to December, resulting in a preweaning mortality rate of 20% in both breeds. The animals were moderately infested with helminths from the middle of the rainy season until early dry season. Trypanosome infections were not detected in WADs, neither were they in the crossbred goats using the buffy coat technique. The average birth weights of crossbred and WAD kids were 2.4 and 2.0 kg, respectively. The growth rate of crossbred kids was significantly higher than that of local kids. The preweaning growth rates of crossbred and WAD kids were 114.75 and 65.57 g/day, whereas the postweaning growth rates were 58.82 and 36.41 g/day, respectively. The fast growth rate of crossbred goats compared to WAD goats indicates that rearing Saanen x WAD crosses in a zero-grazing system can increase productivity. Strict hygiene in the goat sheds, however, is essential to avoid coccidiosis outbreaks.

■ INTRODUCTION

The influence of trypanosomosis and other parasitic infections on the productivity of traditionally extensively-managed trypanotolerant West African Dwarf goats (WADs) under natural challenge has been described (11). Trypanotolerance in WADs has been characterized as an innate ability to remain productive under trypanosomosis risk. Goossens et al. (8) also highlighted the importance of underlying stress factors such as nutrition and management on the expression of trypanotolerance in goats. Mortality of WADs occurs mainly in the rainy season. This is not directly linked to the period with the highest trypanosome prevalence (early dry season), nor to periods with the highest *peste des petits ruminants* (PPR) incidence (the occurrence of PPR is rare due to national vaccination campaigns), but it coincides with the period of lowest packed cell volume (PCV) levels, which are mainly related to high helminth infestations and poor nutritional conditions (8).

Taking into account the urgent demand to improve animal production to feed the growing Gambian population (14), and the increasing conflicts between livestock owners, crop farmers (6) and reforestation projects due to land scarcity (Central River Division Forestry Project of The Gambia, 2002; pers. commun.), it is obvious that increased animal production should be achieved by intensifying production, rather than by increasing animal numbers. Enhanced disease control, integration of fodder production,

1. International Trypanotolerance Centre, PMB 14, Banjul, The Gambia

2. Institute of Tropical Medicine, Nationalestraat 155, B-2000 Antwerp, Belgium

* Corresponding Author
Gaverstraat 26, 9750 Ouwegem, Belgium
Present address: Institute of Agricultural Science of South Vietnam, 121 Nguyen Binh Khiem Street, District 1, Ho Chi Minh City, Vietnam
E-mail: sofiedhollander@yahoo.co.uk

improved husbandry and controlled breeding are essential steps to intensify animal production.

With the aim of intensifying both animal and crop production, an integrated livestock-crop farming system was set up at the International Trypanotolerance Centre (ITC) campus in Bansang. WAD x Saanen crossbred goats were used as animal-component. Crossbreeding trypanotolerant WADs with temperate dairy Saanen goats might be an effective means to increase the genetic potential for milk production and retain some trypanotolerance. Additionally, the possible increased growth rate of the crossbred animals could lead to increased meat production. The purpose of the crossbreeding program, however, is to strictly control the spread of the crossbred animals to small scale, intensified and integrated farming systems, and not to let the crossbred animals roam freely in the villages. For this reason, the male crossbred bucks were castrated to avoid the absorption of the Saanen genes into the trypanotolerant WAD-goat species in the research area, and a pure Saanen flock was maintained for the production of crossbred goats. Finally, an experiment carried out at ITC Bansang station revealed no significant difference in susceptibility to an experimental infection with *Trypanosoma congolense* between WADs and their Saanen crosses (4).

This experiment aimed to study the effect of natural infections, such as trypanosomosis or gastro-intestinal parasites, on the health and productivity of WADs and their Saanen crosses managed in an intensified zero-grazing farming system in The Gambia.

■ MATERIALS AND METHODS

Study site

The study was carried out in Bansang (13° 27′ N, 14° 41′ W), Central River Division South, located 320 km from the Atlantic coast in The Gambia. The area has a low to seasonally moderate tsetse challenge (13). An intensified farming system was set up at ITC campus, where WAD x Saanen crossbreds, food crops and fodder trees were integrated into a zero-grazing farming system. Crossbred goats were fed from inter-cropped legumes and crop residues.

Animals and animal husbandry

The animals used in the trial were born at the beginning of the rainy season 2002 (between June and August) and reared at the integrated farm of ITC campus. Female WAD goats and a Saanen buck (of Belgian origin) were used to produce F1 crosses. All goats were housed in compost sheds built in such a way as to reduce disease risk and optimize production. No netting was used to keep insects outside the shed. The goats were fed in a manger made of timber and cement, designed to prevent droppings from falling into feed or drinking water. The ground was littered with straw that was used for composting.

The kids were weaned at the age of three months (between August and October). Thereafter they were stall-fed with groundnut hay *ad libitum* and received gradually up to 200 g of a concentrate mixture daily consisting of 30% millet, 30% rice bran, 20% cottonseed and 20% groundnut cake, estimated at 0.91 feed units and 166.8 g digestible crude protein per kilogram of dry matter. Before the kids were weaned, the nanny goats were allowed to graze for five hours daily on natural pasture. The kids were always kept on zero-grazing.

Health care

All animals (nannies and offspring) were treated with a fenbendazole anthelmintic (Panacur®, Hoechst), at a dosage of 10 mg/kg at the middle (15 Aug.) and the end (15 Nov.) of the rainy season. This double dosage of fenbendazole anthelmintic administered to goats at strategic intervals was described by Kaufmann (9). The animals also received vaccinations against PPR, pasteurella (National Laboratory for Livestock and Veterinary Research, Dakar) and *Clostridium* (Covexin 8®, Schering-Plough Animal Health).

Experimental design

The experiment took place between July 2002 and July 2003. Twenty (10 males and 10 females) Saanen x WAD crossbred goats (average age of 3 days on 15 July) and 15 (6 females and 9 males) WAD goats (average age of 10 days on 15 July) were monitored during a period of 12 months. The helminth egg output (EPG) and coccidia oocyst output (OPG) per gram of feces, PCV, and trypanosome infection status of the goats were determined monthly.

Rectal fecal samples were collected to determine helminth EPG and OPG using the McMaster technique with a sensitivity of 100 EPG/OPG (18). Jugular vein blood samples were collected with ethylenediaminetetraacetic acid (EDTA) coated vacutainer tubes (4.5 ml), and PCV levels were measured as an estimation of anemia using the capillary microhematocrit centrifugation method. The buffy coat was examined using phase contrast or dark ground microscopy (x 100-400) (10). A number of 50 to 100 fields were examined per sample. Parasitemia was scored using the method of Paris et al. (12).

Statistical analysis

All data were processed using Microsoft Access database, version 7, and analyzed using Stata (17). A random effect negative binomial regression was used to detect differences in weight, OPG and EPG: ln (weight) = cte + $\beta_1$breed + $\beta_2$sex + $\beta_3$age + $^{\upsilon}$animal + error, where "ln" means natural logarithm, and "cte" constant.

■ RESULTS

Parasitic infections

The monthly average OPG of WADs and crossbred goats is shown in figure 1. Mixed coccidia infections were observed throughout the rainy season and the cold dry season. The animals remained free of coccidia during the hot dry season (mid February-June). High oocyst outputs were found from September to December. A peak output of 49,029 OPG (SD = 64,100) was observed in November in F1s and a peak output of 55,716 OPG (SD = 50,154) was observed in the local goats in October. There was no significant difference in oocyst outputs between the breeds. High individual variations in oocyst output were observed, resulting in high standard deviations.

The monthly average nematode egg excretion of the WAD and crossbred goats is shown in figure 2. Mixed nematode infections were observed from the middle of the rainy season until the early dry season (August-December). A maximum average output of 1467 eggs/g (SD = 2772) was found in the local goats in October, and a maximum average output of 586 eggs/g (SD = 1550) was observed in F1s in November. There was no significant difference in nematode egg outputs between the breeds. Two out of 15 WADs showed high egg outputs (10,850 and 9950 eggs per gram of feces) in September, one month after treatment with fenbendazole. No trypanosome infections were detected using the buffy coat method of blood examination in either WADs or crossbred goats between July 2002 and July 2003.

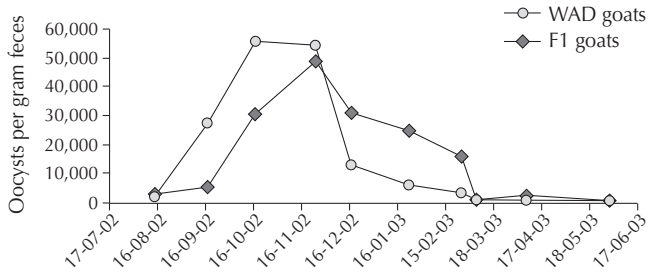

Figure 1: *Monthly average coccidia oocyst output in West African Dwarf (WAD) and crossbred (F1) goats.*

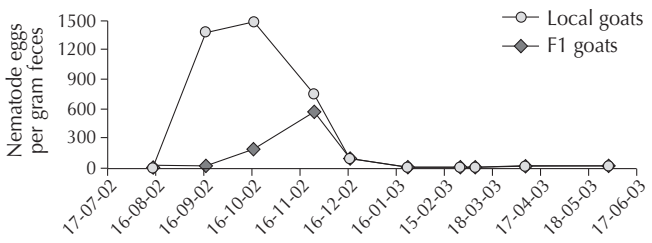

Figure 2: *Monthly average nematode egg excretion of West African Dwarf (WAD) and crossbred (F1) goats.*

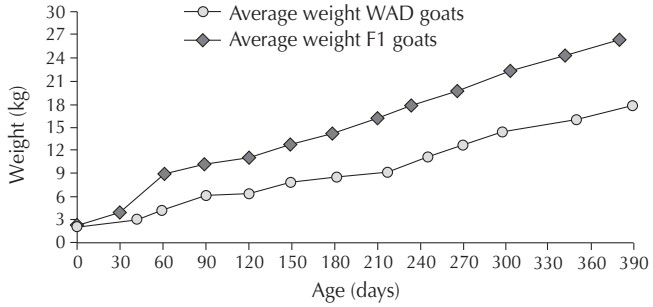

Figure 3: *Monthly average body weights of West African Dwarf (WAD) and crossbred (F1) goats.*

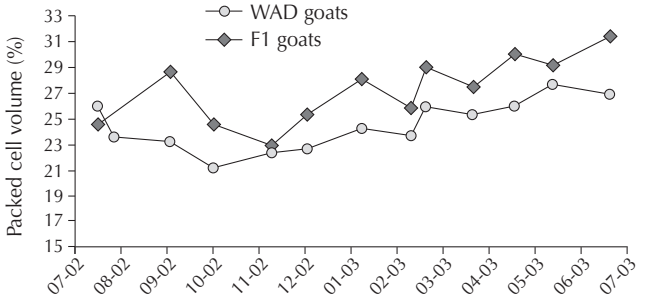

Figure 4: *Monthly average packed cell volume of West African Dwarf (WAD) and crossbred (F1) goats.*

Growth rate

The arithmetic average monthly weights of WADs and crossbred goats are represented in figure 3. The average birth weights of crossbred and WAD kids were 2.4 and 2.0 kg, respectively. The growth rate of crossbred kids was significantly higher (P = 0.018) than that of WAD kids. The preweaning growth rates of crossbred and WAD kids were 114.75 and 65.57 g/day, respectively, while their postweaning growth rates were 58.82 and 36.41 g/day, respectively.

Packed cell volume

The monthly arithmetic average PCVs of WADs and crossbred goats are shown in figure 4. The average PCV of crossbred goats was higher than that of WADs, but no significant difference was observed. Generally, the average PCV remained above 20% during the whole year for both breeds. Minimum PCVs were observed during the rainy season in November in F1s (23%) and in October in WADs (21%).

Clinical observations

Four crossbred and three WAD kids died between the age of one week and four months, resulting in a preweaning mortality rate of 20% in both breeds. The animals had diarrhea and were dehydrated. High oocyst numbers were found in the feces. Postmortem inspection revealed intestinal hemorrhages. Two of the sick animals showed nasal discharge due to simultaneous respiratory infections. All the remaining kids were treated with amprolium HCl (Amprolin-300 ws® Interchemie) at a dosage of 1 g / 3 kg *per os*, during five days, starting on 25 November 2002. There was no postweaning mortality.

■ DISCUSSION

Young goats commonly harbor several species of coccidia and frequently produce oocysts at a rate of 10^5 to 10^6 oocysts per gram of feces without showing clinical symptoms. Disease, however, occurs following stress situations such as weaning, changes in diet, weather or regrouping (9). The clinical coccidiosis observed at the end of the rainy season could have been caused by the harsh climatic conditions resulting in a high degree of humidity and moisture in the goat shed. Unfortunately, the coccidia species involved were not identified. The sick animals showed diarrhea and dehydration, which resulted in a high preweaning mortality of 20% in the kids. In three cases coccidiosis was accompanied by pneumonia. These results are similar to those of Donkin and Boyazoglu (5), who reported that coccidiosis, often accompanied by pneumonia, caused high mortality rates in indigenous South African kids (28%) and their Saanen crosses (24%). Deaths occurred mainly in the first four months.

Vercruysse (19) studied the prevalence of coccidia in extensively managed goats in Senegal. He reported a high prevalence of coccidiosis (85%) as well as moderate oocyst outputs in the range of 1000–5000 oocysts per gram of feces. The disease occurred during the whole year without seasonal fluctuations. The author concluded, however, that the disease risk is likely to increase in more intensive systems of management. The results of this trial confirmed this statement. Coccidiosis appeared to be a major constraint for both young WADs and their Saanen crosses in an intensive farming system during the rainy season. The curative use of amprolium *per os* considerably reduced the oocyst output. The sustainability of the prophylactic use of amprolium *per os*, with regard to the up-coming resistance to the medicine, however, can be questioned.

The average EPG observed during the reported period was low. Nonetheless, during the rainy season peak EPGs of about 600 to 1500 were observed. Since coproculture was not performed, it is difficult to evaluate the impact of these EPG levels. Furthermore, the result was highly influenced by individual variation in EPGs. A more accurate idea would have been obtained if a much larger number of animals had been used in the experiment.

It remains nevertheless remarkable that even low EPGs occurred in animals which were kept on zero-grazing management and which were treated twice with fenbendazole at strategic intervals. Possible sources of infectious larvae in the goat shed could have been the nanny goats that went out for grazing in the preweaning period, before general deworming with fenbendazole took place on 15 August. Chartier et al. (3) studied the effect of internal parasites on zero-grazing adult goats in France and found that the management history of the farms, in which grazing had been practiced six months to three years earlier, related to the occurrence of digestive strongyles. Furthermore, Silvestre et al. (16) determined that the number of farms from which goats originated at the constitution of the herd correlated with the diversity and intensity of helminth infections. The WAD nanny goats used for breeding in this experiment originated from different herds.

Only two out of 15 WADs showed high egg outputs one month after treatment with fenbendazole. Although several authors (2, 7) reported the presence of benzimidazole resistance in nematodes of small ruminants in The Gambia, the fact that only two animals were involved was not suggestive for drug resistance.

The seasonal pattern of nematode egg output in both breeds observed during this study was comparable to the pattern described by Osaer et al. (11) in traditionally managed WADs in the study area. The maximum egg excretion occurred at the end of the rainy season. Reinfestation with helminths during the dry season did not occur, confirming previous observations (1). The drop in PCV at the end of the rainy season reflected the peak in mean nematode EPG and OPG.

Bearing in mind the high helminth challenge and the prevalence of anthelmintic resistance in the study area, it should be recommended to strictly avoid the access of grazing animals in the goat shed. When this measure is put into effect, the use of anthelmintics might be omitted under zero-grazing conditions.

Although the study area has a moderate tsetse challenge (13) and a trypanosome incidence of 3.2% in traditionally managed WADs (11), trypanosome infections did not occur in the stall-fed goats during the observation period of one year. A total animal number of 35 goats, however, is rather small to conclude that stall-feeding might have reduced the occurrence of trypanosomosis. The study results are nevertheless promising. Trypanosomosis did not appear to be a major constraint to rearing Saanen x WAD crosses in an intensive farming system in a moderately tsetse infested area.

The fast growth rate of the crossbred goats compared to the local goats indicated that rearing Saanen x WAD crosses in an intensive farming system could increase meat production and thereby improve food security in rural areas of The Gambia. However, the experiment would have been more revealing if several sires had been used to create the crossbreeds, as there was a confounding effect between breed and sire. In addition, Saanen x WAD crosses might produce more goat milk, which can be a complementary source of proteins, energy and calcium (20, 21), when fresh cow milk or imported milk products are not available or affordable. Serradilla (15) reviewed experiments on the raising of dairy goats in different areas of the world and reported that milk yields of first crossed products (F1s) are usually intermediate between those of exotic and local breeds. Further studies are needed to assess milk production of WAD x Saanen crossbreds and the socio-economic impact of the intensive goat production system.

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Résumé

Dhollander S., Kora S., Sanneh M., Gaye M., Leak S., Berkvens D., Geerts S. Parasitoses des chèvres Naines de l'Afrique de l'Ouest et de ses croisements avec la race Saanen dans un système d'agriculture zéro-pâturage en Gambie

L'étude a concerné l'élevage de 20 chèvres Naines de l'Afrique de l'Ouest (NAO) et 15 croisements Saanen x NAO au sein d'un système d'agriculture zéro-pâturage intensif dans une zone peu à moyennement infestée de mouches tsé-tsé en Gambie. Pendant une période d'une année, des échantillons ont été prélevés mensuellement pour déterminer le nombre d'œufs d'helminthes, le nombre d'oocystes de coccidies par gramme de matières fécales, les valeurs de l'hématocrite et les trypanosomoses des chèvres. Des nombres élevés d'oocystes ont été trouvés pendant la période de septembre à décembre, entraînant une mortalité présevrage de 20 p. 100 chez les deux races. Les animaux ont été modérément infestés par les helminthes du milieu de la saison des pluies jusqu'au début de la saison sèche. Des trypanosomoses n'ont été détectées ni chez les NAO ni chez les chèvres croisées lors de l'utilisation de la technique du *buffy coat*. Les poids moyens à la naissance des chevreaux et des NAO ont été respectivement de 2,4 et 2,0 kg. Le taux de croissance des chevreaux croisés a été significativement plus élevé que celui des chevreaux de race locale. Les taux de croissance présevrage des chevreaux croisés et des NAO ont été respectivement de 114,75 et 65,57 g/jour, tandis que les taux de croissance postsevrage ont été de 58,82 et 36,41 g/jour. Le taux de croissance rapide des chèvres croisées comparé à celui des NAO indique que l'élevage de croisements Saanen x NAO dans un système zéro-pâturage peut accroître la productivité. Une hygiène stricte dans les abris des chèvres est cependant indispensable pour éviter l'apparition de foyers de coccidiose.

Mots-clés : Caprin – Chèvre Naine – Croisement – Helminthe – Coccidiose – Trypanosomose – Affourragement en vert – Gambie – Afrique de l'Ouest.

Resumen

Dhollander S., Kora S., Sanneh M., Gaye M., Leak S., Berkvens D., Geerts S. Infecciones parasitarias en las cabras Enanas de Africa del oeste y sus cruces Saanen en un sistema de cría sin pastoreo en Gambia

Se manejaron 20 cabras Enanas de Africa del oeste (WAD) y 15 cruces Saanen x WAD con un sistema de cría intensivo, sin pastoreo, en una zona con riesgo bajo a moderado de tsé-tsé, en Gambia. Durante un año, se recolectaron muestras mensuales con el fin de supervisar los resultados de oocistos de coccidia (OPG) y los huevos de helmintos (EPG) por gramo de heces, el hematocrito (PCV) y parasitemia por tripanosomas en las cabras. Se encontraron altos OPG entre septiembre y diciembre, resultando en una mortalidad pre destete de 20% en ambas razas. Los animales se encontraron moderadamente infestados con helmintos a partir de la mitad de la estación lluviosa y hasta los inicios de la estación seca. Con la utilización de la técnica del *buffy coat* no se detectaron infecciones por tripanosomas en las WAD, ni en las cabras producto de cruces. Los pesos promedio al nacimiento de los cabritos provenientes de cruces y de los WAD fueron de 2,4 y 2,0 kg respectivamente. La tasa de crecimiento de los cabritos de cruces fue significativamente mayor que la de los locales. Las tasas de crecimiento pre destete de los cabritos de cruces y de los WAD fue de 114,75 y 65,57 g/día, mientras que las tasas de crecimiento post destete fueron de 58,82 y de 36,41 g/día respectivamente. La rapidez en la tasa de crecimiento de los cabritos de cruces en comparación a los WAD indica que la cría de cruces Saanen x WAD en un sistema sin pastoreo puede aumentar la productividad. Sin embargo, una higiene estricta en los establos es esencial para evitar los brotes de coccidiosis.

Palabras clave: Caprino – Cabra enana – Cruzamiento – Helminto – Coccidiosis – Tripanosomosis – No pastoreo – Gambia – Africa Occidental.