Effects of a protein supplement and anthelmintic treatment on communally grazed Tswana goats naturally infected with gastrointestinal nematodes.

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Abstract: This study was carried out to determine the effects of anthelmintic treatment and protein supplementation on health and productivity of indigenous Tswana goats. Thirty six goats of around 1 year old and of unspecified breeds were randomly divided into 4 groups of 9 animals each. The first group was treated with an oral dose of albendazole every three months. The second group was fed protein supplement daily, while the third group was drenched every three months and fed protein supplement daily. The fourth, control group was neither drenched nor fed supplement. The control group generally had higher eggs per gram (EPG) counts than the 3 treatment groups, with the highest peak in January. There was no significant difference in EPGs between the protein and the anthelmintic groups, while the protein supplemented animals had significantly lower mean egg counts than the controls. The anthelmintic/protein group had significantly reduced faecal nematode egg counts when compared to the other 3 treatments. The protein and the protein/anthelmintic groups gained significantly more weight than the anthelmintic group, while the anthelmintic group also gained significantly over the control group. The protein supplemented and anthelmintic- treated groups had significantly higher PCV values than the controls. No significant differences were observed for albumin among the groups. The additive helminth control effect of anthelmintic and protein supplementation combinations may go a long way in curbing the rampant use of anthelmintics that has the potential of promoting drug resistance.
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Key words: additive effects, anthelmintic treatment, gastrointestinal nematodes, protein supplement, Tswana goats.

1. Introduction

Small ruminants constitute a major source of protein for human nutrition in tropical and subtropical regions. However, production levels are low because of a number of factors which include poor nutrition, diseases, parasitism and poor management. While poor nutrition is considered the most critical factor, diseases and parasitism are a major source of economic loss (Coop and Holmes 1996; Ng'ang'a *et al*. 2009). Complete eradication of gastrointestinal parasites of small ruminants is impractical and undesirable (Vlassoff *et al.* 2001; Waller 2006). The main objective of control programs should therefore be to minimize associated economic losses by containing parasite populations at levels that do not significantly affect production of their hosts. In control programs, nematode populations can be maintained at low levels by strategic use of anthelmintics which may also in the end lessen development of high rate of anthelmintic resistance in small ruminants (Vlassoff *et al.* 2001; Van Wyk *et al.* 2006; Waller 2006). Traditionally, anthelmintics have been the most popular and widely used means of controlling helminth parasites. Cases of resistance to anthelmintics by populations of different nematode genera in South Africa has been reported (Van Wyk *et al*. 2006). A potential risk of selection for drug resistance in small stock exists, and added to the high cost of anthelmintic drugs, research into alternative control strategies is necessary. Possible alternatives include selective breeding of resistant animals, development of vaccines and better nutrition.

There is evidence that the level of dietary protein intake significantly boosts the immune response of the host to helminth infection (Coop and Holmes 1996). In South Africa's communal areas, the pastures are generally of poor quality and there is need therefore for supplementary feeding of small stock, especially in the dry seasons. The availability of low cost protein sources of protein supplement for use by communal farmer like cotton seed cake and ground nut husks enhances the nutritional resources that can be provided to the animals and reduces the detrimental effects of gastrointestinal parasites on the animals, resulting in substantial increase in productivity. This study was therefore carried out to determine the effects of anthelmintic treatment and protein supplementation in indigenous Tswana goats on their productivity.

2. Materials and methods

Study area and study design

This study was conducted at North West university farm, 7km from Mafikeng (25° 52'S and 25° 38'E) city in the North West province of South Africa from July 2008 to June 2009. Mafikeng has an altitude of 1278m above sea level. It is a semi-arid environment with Savanna type vegetation and summer annual rainfall of 540 mm year $^{-1}$. It has one long dry season (winter) extending from May to October and a relatively short wet season (summer) extending from November to February. The meteorological data for Mafikeng for the last 18 years is shown in Fig. 1

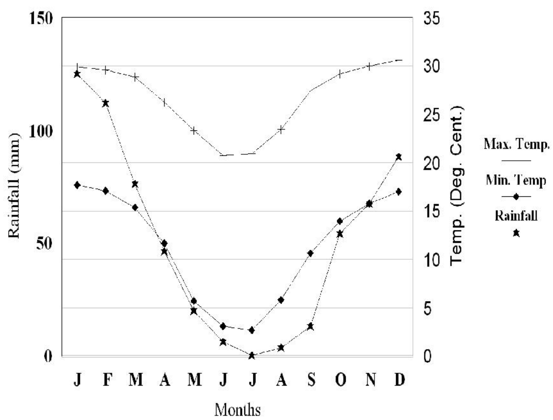

Figure 1. Average rainfall (mm) and temperature (°C) data for Mafikeng over an 18 year period.

A total of 36 approximately 1 year old indigenous goats of unspecified breeds were bought from different communal farmers, ear-tagged and randomly divided into 4 groups of 9 animals each. The 1st group was treated with an oral dose of albendazole (Prodose Green, Virbac Animal Health) at a rate of 7.5 mg/kg live mass, every three months. The 2nd group was fed a daily protein (Protein ram pellets, reg. no. V1482 Act 36/1947) supplement at the rate of 75g per animal for the duration of the study, and as ecommended by Barrick and Harmon (1988) for daily maintenance. The 3rd group was drenched every three months and fed a daily protein supplement. The 4th, control group received non of the above treatments.

All the groups were housed at night in a 30m x 30m camp that was partially roofed, with a dirt floor. Water was provided ad lib in the camp. The animals were let out to graze daily on natural pasture on communal rangelands during the day and no other supplement was given. The goats grazed freely with other communal indigenous goats, sheep, and cattle.

Parasitological procedures

Monthly rectal faecal samples were collected from each animal during the study. The modified McMaster technique (Reinecke 1983) was used for the determination of worm egg counts per gram of faeces (EPG).

Health and Productivity parameters

EDTA and whole blood samples were collected monthly from the jugular vein of each animal to determine packed cell volume (PCV) and albumin, respectively using routine methods. Live weights of the animals were recorded at the beginning and every month throughout the study.

Statistical analysis

One way analysis of variance was performed using the statistical package for social scientists (SPSS) version 13 to determine whether the treatment with albendazole alone, albendazole/Protein or Protein alone would have an effect on blood PCV, serum albumin, faecal egg counts or weight gain of the goats. Least significant means was calculated for monthly differences of variables. Turkey-Kramer Adjustment for multiple comparisons was also employed. The comparison of blood PCV, EPG, weight gain and albumin among the four groups was done using T-test two samples assuming equal variance. Probability was considered significant at $p<0.05$ or less.

Results and discussion

The monthly geometric nematode eggs per gram of faeces (EPG) for the 4 groups are shown in Fig. 2. The control group generally had higher EPG counts than the 3 treatment groups, with the highest peak in January and the lowest in June. During the rainy season (November to February), environmental conditions were ideal for the development of the infective larvae on pasture. It is during this period that faecal egg counts began to rise, reaching their highest peak in January. The lowest faecal egg counts in June may be attributed to the dry conditions and low temperatures (Fig. 1) that were unsuitable for the development of the free-living larval stages. These findings are in agreement with the seasonal patterns reported previously for gastrointestinal nematodes of communally grazed cattle in Southern Africa (Vassilev 1994).

Table 1: Comparison of mean± standard error of eggs per gram of faeces (epg), packed cell volume (PCV), live weight change and albumin between the 4 groups.

Group	n	EPG(g)	PCV(%)	Weight change (kg)	Albumin(μg/ml)
Prot	9	424[b]±29	34.4[a]±1.42	4.92[a]	2943[a]±24.5
Prot/Ant	9	374[c]±24	35.1[a]±1.23	4.80[a]	2920[a]±42.5
Ant	9	490.7[b]±32	33.2[a]±11.5	3.47[c]	2912[a]±23.0
Control	9	783[a]±44	27.9[b]±1.19	-0.73[b]	2940[a]±20.8

Values without a common superscript letter within a column are significantly different ($p < 0.05$). Prot- protein, Ant- anthelmintic.

There was no significant difference in EPGs between the protein and the anthelmintic groups although the mean EPG for the protein group was lower (424 vs 490.7) (Table 1). Improved nutrition, particularly of protein, has been shown to enhance resistance and resilience of sheep to gastrointestinal nematode infections (Wallace *et al.* 1996; Knox *et al.* 2006). The daily maintenance levels of protein for each animal in this study may not have been high enough to cause a significant counter effect on the gastrointestinal nematode infection. Probably if increased amounts of metabolisable protein had been given to the animals, significant differences could have been observed. However, the protein supplemented animals had significantly lower mean egg counts than the controls (Table 1).

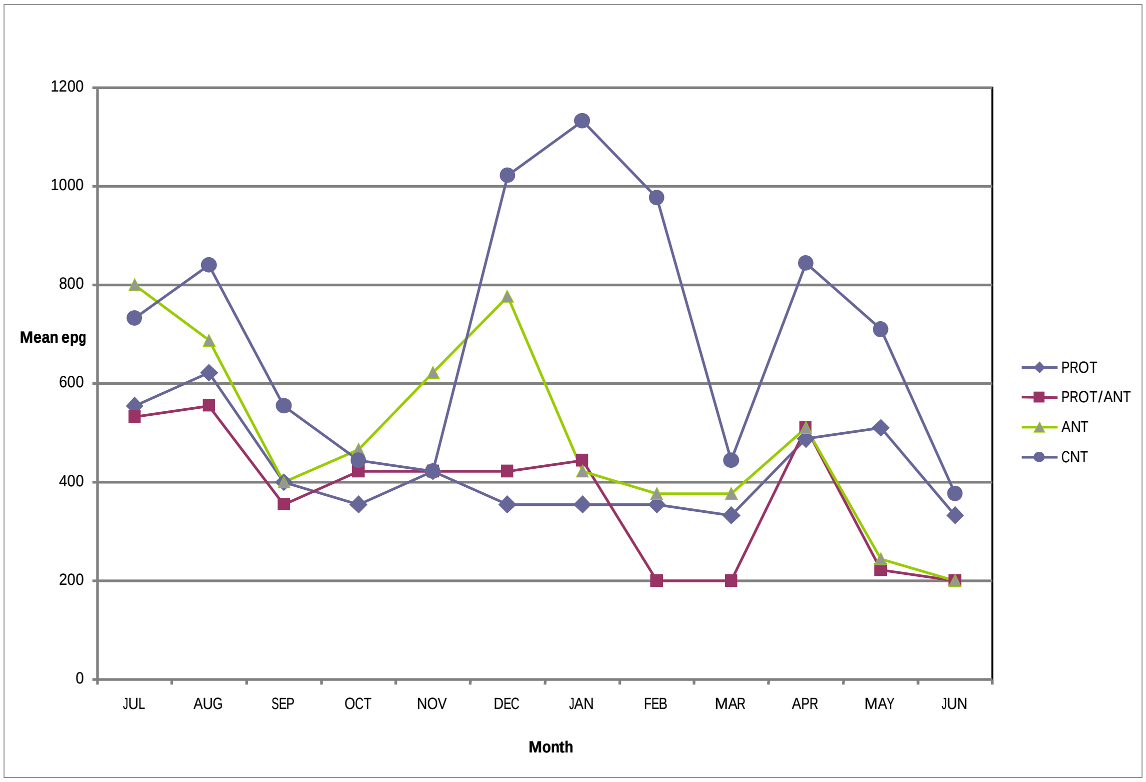

Figure 2. Mean monthly fecal EPG.

The anthelmintic/protein group had significantly ($p< 0.05$) reduced faecal nematode egg counts as compared to the other 3 treatments (Table 1). This clearly indicated the additive effect of protein and anthelmintic on nematode performance. The protein boosted the immune system of animals such that they could withstand nematode infection while the anthelmintic directly eliminated the nematodes. This protein/anthelmintic superiority in suppressing faecal egg output has also been reported previously in cattle (Magaya *et al.* 2000).

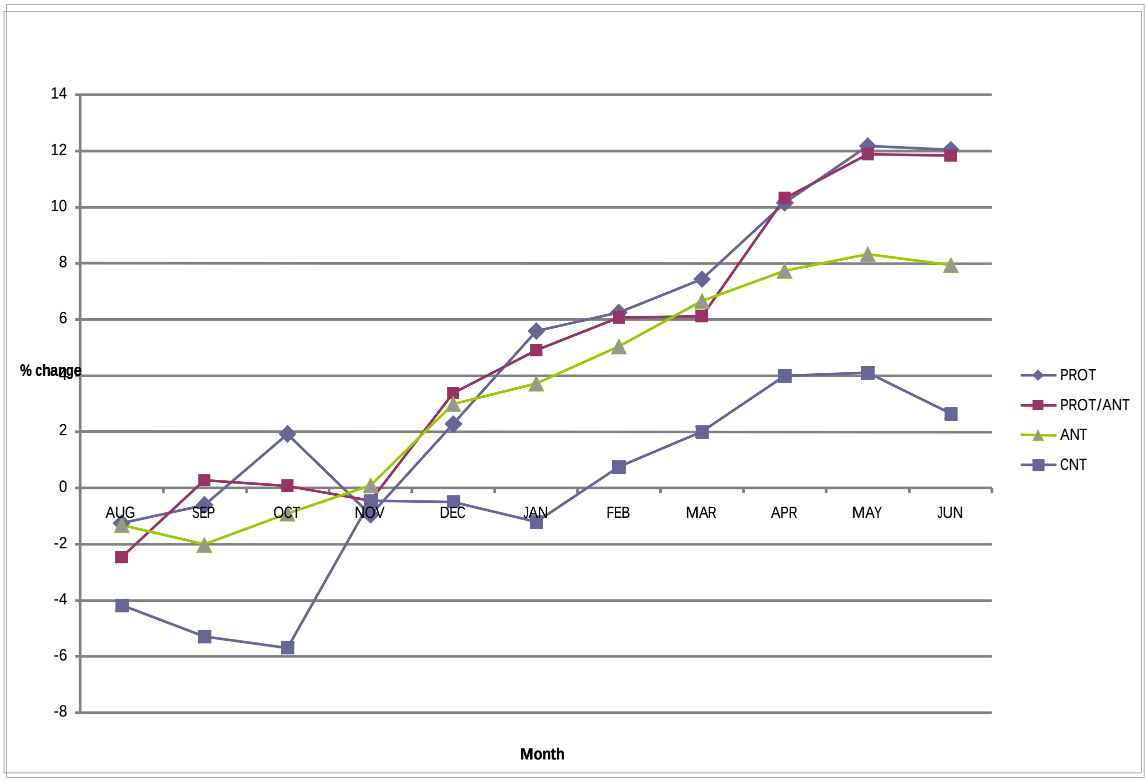

Figure 3. Mean monthly body weight changes.

Figure 3 shows the mean monthly live weight changes of the animals for the duration of the study. The percentage weight changes fluctuated in the 4 groups in the dry months of August to October 2008 and then started rising from the wet months of November and reached the highest peak in May 2009. At the end of the study, the protein and the protein/anthelmintic groups had gained significantly more weight than the anthelmintic group ($p<0.05$), while the anthelmintic group gained significantly over the control group (Table 1). The weights of all animals in all groups were low at the beginning of the trial from the months of August to November because the pasture was dry and of low nutritive value. Unexpectedly, the animals that benefited from both anthelmintic and protein supplement did not gain as much weight as those that received protein supplement alone (Table 1), a finding that was also noted by Magaya *et al*. (2000). This might be possibly due to the depressive effects of albendazole on rumen digestion. Albendazole is one of the benzimidazole compounds which have been shown to adversely affect rumen fermentation by suppressing cellulolytic and carbohydrate dependent microorganisms (Hodgson and Jessop 1987).

After the rains in November the pasture improved and all the animals began to gain weight up to May. It is important to note that the protein group out-performed the protein/anthelmintic group, the anthelmintic group, and the control group with respect to live weight gain (Table 1). This implies that dietary protein supplementation does improve productivity of goats on pastures with subclinical gastrointestinal nematode infection, as measured by weight gain. This is in fair agreement with previous findings in sheep by Van Houtert *et al*. (1995) and Magaya *et al*. (2000) in cattle after using sunflower meal and cotton seed cake respectively.

Mean monthly values for PCV are shown in table 1 for all the 4 groups. At the beginning of the study there were no significant differences in PCV among the 4 groups and thereafter, PCV values fluctuated between the groups. At the end of the trial, the protein supplemented and anthelmintic- treated groups had significantly higher ($p< 0.05$) PCV values than the controls (Table 1) and also tended to be higher than in the protein/anthelmintic group, though not statistically significant. Protein supplementation of young sheep infected with gastrointestinal nematodes has been shown to limit the decline in PCV (Shaw *et al*. 1995). It is therefore, possible, that an increment in the amount of protein supplemented would have resulted in a significant difference.

The mean monthly albumin values are shown in table 1 for all the 4 groups. No statistically significant differences (p>0.05) were noted among the 4 groups. This may probably be due to the fact the nematode infections were not severe enough to cause significant protein losses in the untreated animals. Similar non-significant effect on albumin values has previously been reported in cattle by Magaya *et al*. (2000).

Conclusion

The additive helminth control effect of anthelmintic and protein supplementation revealed in this study may go a long way in curbing the rampant use of anthelmintics that has the potential of promoting drug resistance. This will also be in line with the concept organic farming that is currently being promoted.

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