An evaluation of protein, mineral supplements and anthelmintic treatment on communally managed sheep, naturally infected with gastrointestinal nematodes.

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Abstract: This trial was conducted to determine the effects of anthelmintic treatment together with protein and dicalcium phosphate supplements on sheep performance, reared on communal rangelands for 2 years. fourty female Dorper sheep of around 1 to 2 years old were randomly alloted into 4 groups of 10 sheep each. The first group was orally drenched with fenbendazole at an interval of three months. The second group was given protein pellets daily while the third group was dosed every three months and fed protein pellets daily together with dicalcium phosphate lick. The fourth control group was neither dosed nor fed mineral and protein supplements. The 3 treatment groups had generally lower eggs per gram (epg) of faeces than the control group. The anthelmintic/protein/dicalcium phosphate group had significantly reduced faecal nematode egg counts when compared to the other 3 treatments, with the protein and anthelmintric groups displaying the same effect but much lower than the control group. The same trend was displayed by all the groups in terms of body mass gain. The protein, dicalcium phosphate supplemented and anthelmintic treated group had significantly higher PCV values, followed by protein, anthelmintic and control groups respectively. There was a significant difference observed between the protein, mineral supplements and anthelmintic treated group for albumin as compared to other 3 groups which did not differ significantly. The synergistic nematode control effect of using anthelmintic treatment, protein and mineral supplementation combinations may go a long way in reducing the rampant use of anthelmintics that have led to the potential development of anthelmintic resistance.
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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 farmers 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, protein and mineral supplementation in Dorper sheep on their performance.

2. Material and Methods

This work was carried out at Mafikeng (25° 52'S and 25° 38'E) on the North West University farm from July 2010 to June 2012. Mafikeng, at an altitude of 1278m above see level, is semi-arid with savanna type vegetation. It has one long dry season extending from May to September and a short wet season extending from November to February. The meteorological data for Mafikeng for the two years of trial period is shown in Fig. 1

Figure 1 Mafikeng meteological data.

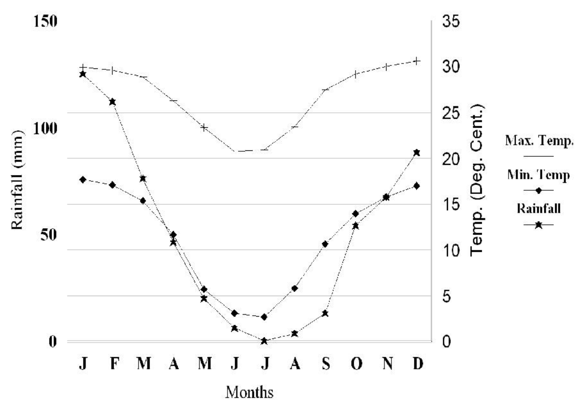


Figure 1. Average rainfall (mm) and temperature (°C) data for Mafikeng ttrialperiod (July 2011-June 2012).

A total of forty Dorper sheep were purchased from one commercial farmer, ear-tagged and randomly divided into 4 groups of 10 animals each. The 1st 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 (Barrick and Harmon (1988) for daily maintenance. The 2nd group was dosed with fenbendazole (Prodose Green, Virbac Animal Health) at a rate of 7.5 mg/kg live mass, every three months. The 3rd group was drenched every three months and fed a daily protein supplement as in group one together a mineral supplement given ad lib in the evenings. The 4th group received no treatment and served as a control. All the 4 groups were housed at night in roofed kraals where water and supplements were given. All the 4 groups were released daily in the mornings on the communal rangelands around the university farm where they grazed freely with goats and cattle. Throughout the trial period one male Dorper was used and stayed with the females for two months from the beginning of November to the end of December of each year. Rectal faecal samples were collected on a monthly basis and a modification of McMaster technique (Reinecke,1983) was use to determine the nematode eggs (epg) per gram of faeces. Blood was collected from all animals monthly and packed cell volumes and albumin, respectively were determined using routene methods. The weight changes were done monthly using a manual scale. One way analysis of variance was performed using the statistical package for social scientists (SPSS) version 13 to determine whether the treatment with fenbendazole alone, fenbendazole/Protein or Protein alone would have an effect on blood PCV, serum albumin, faecal egg counts or weight gain of the sheep. 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 change and albumin among the four groups was done using T-test two samples assuming equal variance and Probability was considered significant at $p<0.05$ or less.

3. Results

Figure 2 below represents the mean monthly body weight changes of the 4 groups of sheep for the 2 years of the trial period. In the dry months of August to October the 4 groups of animals displayed a non linear low weight change which started rising linearly in the wet month of November until May. In the dry months (August to October) all animals apparently lost weight due to poor pasture with low nutritive value. After the rains in November the pasture improved and all the animals began to gain weight up to May.

Figure 2. Mean weight changes in 2 years

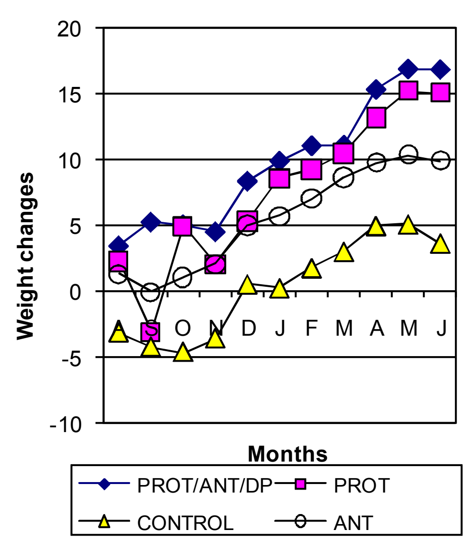


Figure 2 also shows that the weight curves in all groups looked almost parallel and similar, indicating that the growth rates were similar among all the 4 groups. Similar results were report ed previously by Magaya et al (2000) in steers. At the termination of the study the PROT+ANT+DP, PROTand ANT groups had gained significantly more ($p < 0.05$) weight than the CONT group (Table 1).

However there was no statistical significance between the weight changes of the PROT and ANT groups though the PROT group tended to display more weight gain. The low weight change in the ANT group, though not significant from the PROT group might be possibly due to the depressive effects of fenlbendazole on rumen digestion. Fenlbendazole 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). It is important to note that PROT+ANT+DP group out-performed the PROT, ANT and the CONT groups with respect to live weight gain (Table 1). This implies that dietary protein, mineral supplementation and anthelmintic treatment synergistically does improve productivity of sheep on pastures with subclinical gastrointestinal nematode infection, as measured by weight gain. The protein improves the animal's immune system while the phosphorus supplement increases the animal's feed intake and utilization and the anthelmintic reduces the nematode load which compromises feed utilisation (Knox et al, 2006).

The mean monthly nematode eggs per gram of faeces (epg) for two years for the 4 groups of sheep are shown in Fig. 3. The epg in all the 4 groups of animals followed the same trend as that displayed in the weight gain changes above in figure 2. The treatment groups had generally lower epg counts than the control group (Fig. 3 and Table 1).

In all cases the highest peaks were observed in wet months of November to January and the lowest in the months of June to August (Fig. 1). During the rainy season, environmental conditions like moisture, warmth and air are ideal for the development of the infective nematode larvae on pasture. It is during the wet season 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 as shown in Fig.1 Such dry conditions and low temperatures are unsuitable for the development of the nematode infective larvae. These findings are in agreement with the seasonal patterns reported previously for internal parasites of communally grazed cattle, sheep and goats (Vassilev 1994; Bakunzi and Serumaga-Zake, 2000).

Table 1: Comparison of mean live weight, packed cell volumes, albumin, and eggs per gram (epg) of faeces between the 4 groups.

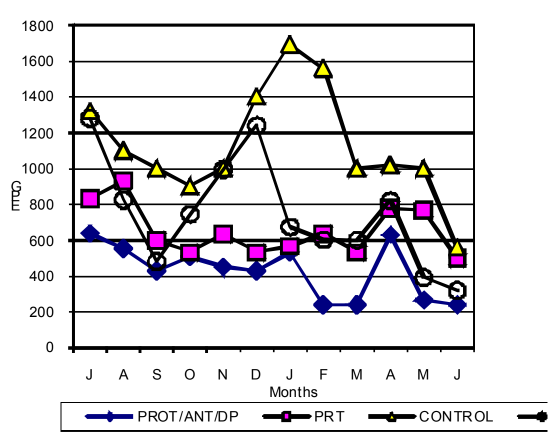
Group	n	Weight (kg)	PCV (%)	Alb (µg/ml)	EPG (g)
PROT/ANT/DP	9	10.47^{a}	38.3^{a}	3024^{a}	429^{a}
PROT	9	7.78^{b}	35.7^{b}	2843^{b}	680^{b}
ANT	9	6.60^{b}	32.1^{c}	2791^{b}	747^{b}
CONT	9	0.27c	26.8^{d}	2847^{b}	1169^{c}

Values without a common superscript letter within a column are significantly different ($p < 0.05$).

No significant difference was shown in eggs between the protein and the anthelmintic groups although the mean epg for the protein group was lower (680 vs 747) (Table 1). Protein supplements have been shown to enhance resistance and resilience of livestock to gastrointestinal nematode infections (Wallace *et al.* 1996; Knox *et al.* 2006). Probably if the animals had been given higher amounts of a protein supplement, significant differences could have been observed. However, the protein supplemented animals had significantly lower mean epg counts than the controls (Table 1).

The protein/anthelmintic/dicalcium phosphate group had significantly ($p < 0.05$) reduced faecal nematode egg counts when compared to the other 3 treatment groups (Table 1). This clearly indicated the synergistic effect of protein, anthelmintic and mineral supplement on sheep performance. The protein boosted the immune system of animals such that they could withstand nematode infection while the anthelmintic directly eliminated the nematodes (Knox et al, 2006). The calcium and phosphorus elements improved the animals' numerous body functions so as to withstand nematode infection.

Figure 3 Mean fecal EPG in 2 years



Mean monthly values for the two years for PCV are shown in table 1 for all the 4 groups. There were no significant differences at the beginning of the trial between all the groups and thereafter, PCV values fluctuated between the groups. At the end of the trial period, the PROT+ANT+DP group had significantly higher ($p < 0.05$) PCV values than the other 3 groups (Table 1). The final rank order of PCV of the groups was PROT+ANT+DP > PROT> ANT > CONT. As discussed above for live weight gain and epg, the summative effect of protein, anthelmintic and mineral supplement improved PCV compared to either protein or anthelmintic alone. In the absence of the 3 combinations, either protein or anthelmintic can be used to eliminate nematodes as well as to improve the animal's PCV (Shaw *et al*. 1995).

The mean monthly albumin values are indicated in table 1 for all the 4 groups of animals. The PROT+ANT+DP group significantly displayed higher ($p<0.05$) albumin values as compared to the other 3 groups (Table 1). However, there was no statistical significance between these 3 groups. The superiority displayed by the combination of the 3 treatments in improving body albumin most probably is attributed to the additive effect of protein, anthelmintic and mineral supplements on albumin preservation in the body. The none significant effect between the protein, anthelmintic and control groups was probably due to the fact that nematode infections were not so severe enough to cause significant protein losses in the untreated animals. Similar non-significant effect on albumin values has previously been reported (Magaya *et al,* 2000).

Conclusion

The additive helminth control effect of anthelmintic, protein and mineral 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.

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