A survey on anthelmintic resistance in nematode parasites of communally grazed sheep and goats in a rural area of North West Province, Republic of South Africa.

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Abstract: Anthelmintic resistance was investigated between January and March of 2010 using the Faecal Egg Count Reduction (FECR) test on 40 each of communally grazed smallholder sheep and goats in a rural area of the North West Province of South Africa. Fecal egg count decreases below 95% were considered to imply resistance to the respective anthelmintics. Results revealed no overall resistance to all the anthelmintics studied in sheep (ų = 96-98%), while an emerging trend of resistance was noted in goats (ų =71.8- 93%). Only 10% of the sheep farms exhibited resistance to albendazole and ivermectin while 40% showed resistance to closantel. Among goat farms, 40% exhibited resistance to albendazole and closantel, while 60% revealed resistance to ivermectin, implying a farm specific trend as well. On a comparative basis, resistance to all 3 drugs was lower in sheep than in goats. The anthelmintic resistance revealed in goats and on some sheep farms is a cause for concern about the possible spread of resistance that is rampant on numerous commercial sheep farms in South Africa.
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1. Introduction

Anthelmintic resistance in sheep and goats has widely been reported throughout the world, including Southern Africa [1, 2, 3, 4, 5]. The reports have mainly involved well resourced commercial farming systems that have unlimited access to anthelmintics. Parasitism together with other factors that include poor nutrition, diseases, and poor management have been cited as a major impediment to production in small stock [6, 7]. Small stock, goats included play an important role in the economic and socio-cultural lives of rural communities where they also serve during rituals [8]. Despite the importance of small stock to disadvantaged communities, little data is available on the extent of anthelmintic resistance in such farming systems [1, 9]. The aim of this study was therefore to evaluate the efficacy of 3 commonly used anthelmintics in small holder, communally grazed sheep and goats.

2. Material and Methods

This study was conducted at Kraaipan, about 100km from Mafikeng city (25^o 52'S and 25^o 38'E) in the North West Province of South Africa. The area has a semi-arid environment with Savanna type vegetation. The annual summer rainfall of 540 mm year $^{-1}$ is experienced. The region has one dry season that extends from May to September, and a wet season that extends from October to February. The mean monthly meteorological data for Mafikeng for the last 18 years is presented in Figure 1.

Faecal samples were collected between the months of January and March of 2010. Forty animals from 10 small holder farms each of communally grazed sheep (predominantly Dorper and Merino crosses) and goats (mainly indigenous crosses) were randomly selected for inclusion in the study. The animals were of different sexes and ages, all above one year old as determined by dental eruption.

The animals were ear tagged, weighed and randomly assigned to 4 treatment groups per farm (Table 1). Pre-treatment samples were collected directly from rectums of the animals and placed in plastic bottles pending analysis. Post-treatment samples were collected 12-14 days after treatment. Faecal egg counts were done using a modification of the McMaster technique [10]. The arithmetic mean of the individual counts before and after treatment was calculated for each group.

Table 1: Sheep and goat groups with respective anthelmintic treatments.

Animal group	Treatment	Dosage (mg/kg)
1	Albendazole	7.5
2	Ivermectin	0.2
3	Closantel	5.0
4	Control	0.0

Faecal egg count reduction percent (FECR%) was calculated as per Bauer and Gerwert [11]: **FECR % =** $(1 - T_2/T_1 \times C_1/C_2) \times 100$

Where T and C represent the arithmetic means of the egg counts for the treated and control animals respectively. Subscripts 1 and 2 designate the egg counts of the animals before and after treatment respectively. The cut-off point for anthelmintic efficacy was considered at 95% reduction in egg counts, in accordance with accepted guidelines of the World Association for Advancement of Veterinary Parasitology (W.A.A.V.P) [12, 13].

Nematode identification was done to genus level after Van Wyk *et al*. [14], using about 2 grams of faecal samples incubated at 25°C for 5 days to harvest third stage larvae (L_3).

3. Results

Tables 2 and 3 show the anthelmintic efficacies of albendazole, closantel and ivermectin for sheep and goats respectively for the 10 small holder farms involved. The efficacies for albendazole, closantel and ivermectin in sheep ranged from 89 to 100% (ų= 97%), 92 to 100% (ų= 98%**)** and 94 to 100% (ų= 96%**)** respectively. Those for goats ranged from 64 to 100% (ų= 91.8%), 83 to 100% (ų= 71.8%) and 76 to 100% (ų= 93.1%) respectively (Table 3).

Table 2. Anthelmintic efficacy (%) in sheep.

	FARMS										
Drug	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**ų**
ABZ	96	95	100	100	100	100	95	95	89	100	97
IV	100	96	100	100	100	95	95	94	100	100	98
CLO	92	94	100	100	94	95	100	94	95	96	96

ABZ- albendazole, IV- ivermectin, CLO- closantel.

Only 10% of the sheep farms exhibited resistance to albendazole and ivermectin while 40% showed resistance to closantel. Among goat farms, 40% exhibited resistance to albendazole and closantel, while 60% revealed resistance to ivermectin, implying a farm specific. On a comparative basis, resistance to all 3 drugs was more pronounced in goats.

Based on the 95% cut-off as recommended by W.A.A.V.P. [12, 13] for anthelmintics resistance, current results show no overall resistance to anthelmintics in sheep (Table 2), while higher resistance trends were established in goats. The sheep results are suggestive of lower prevalence of anthelmintic resistance than that on commercial sheep farms in South Africa [1]. This could be related to the infrequent use of anthelmintics by resource-poor communal farmers [15]. There may therefore still be good prospects of slowing down the development of severe anthelmintic resistance against the commonly used anthelmintics in communally grazed sheep.

Table 3. Anthelmintic efficacy (%) in goats on 10 farms.

	FARMS										
Drug	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**ų**
ABZ	100	64	100	86	87	95	100	96	90	100	**91.8**
IV	100	91	96	93	100	92	88	98	76	84	**71.8**
CLO	83	89	95	85	97	95	89	100	98	100	**93.1**

ABZ- albendazole, IV- ivermectin, CLO- closantel.

Results involving goats generally revealed higher levels of resistance to anthelmintics. This could have been due to an apparent under-dosing related to the fact that anthelmintics are metabolized more in goats than in sheep, with goats consequently requiring dose rates 1.5-2 times higher than those for sheep [16], yet in the present study, similar dose rates were employed between the two animal species.

Results also revealed farm specific resistance trends for some of the drugs, especially involving goats, indicating the presence of resistant nematode populations on the particular farms. The anthelmintic resistance could be due to under-dosing as a result of limited financial resources among communal farmers [15]. Underdosing allows the survival of heterozygous resistant worms which contribute to selection of resistant strains [17]. In addition to underdosing, emerging farmers often buy in animals from commercial farms at auctions, thereby aiding in dissemination of drug resistant worms [15]. The occurrence of anthelmintic resistance in the smallholder farming sector is a cause for concern, and steps should be taken to prevent its further spread, as is the situation on commercial sheep farms in South Africa [18]. According to Papadopoulos [16], such steps include increasing the number of untreated animals on the farm (refugia) by using the FAMACHA system to identify anaemic animals to be treated, quarantining of new animals, breeding tolerant animals, introducing nematophagus fungi and plants containing condensed tannins as alternatives to chemotherapy, as well as improving the quality of nutrition by supplementing protein.

The most prevalent genus recovered in goats was *Haemonchus* followed by *Trichostrongylus* and *Oesophagostomum* spp respectively, while in sheep it was *Haemonchus* followed by *Oesophagostomum* and *Trichostrongylus spp* respectively.

A similar pattern has previously been reported in communally grazed goats and sheep, as well as in summer rainfall areas [18, 19, 20].

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