J. Vet. Malaysia (2011) 23(1): 19 - 23

ANTHELMINTIC RESISTANCE OF SELECTED GOAT FARMS IN TERENGGANU

A.A. Nor-Azlina,[1] R.A.Sani[2*] and O.M. Ariff[2]

[1] *Faculty of Agriculture and Biotechnology, Universiti Sultan Zainal Abidin, Kampus Kota, Jalan Sultan Mahmud, 20400, Kuala Terengganu, Malaysia*
[2]*Faculty of Veterinary Medicine, Universiti Putra Malaysia, 43400 UPM, Serdang, Selangor, Malaysia*

SUMMARY

A study was conducted to examine the current status of anthelmintic resistance of strongyles in goats raised in selected farms in Terengganu, Malaysia. The fecal egg count reduction test (FECRT) was performed with anthelmintics tested being benzimidazole, levamisole, ivermectin and closantel. Results indicated that all farms exhibited resistance towards benzimidazole and closantel while only two farms were still susceptible to levamisole and one farm exhibited suspected resistance to ivermectin. Four farms exhibited resistance to all anthelmintics tested. The strongyles which had developed anthelmintic resistance were predominantly *Haemonchus contortus* followed by *Trichostrongylus spp.* Results obtained from this study provide further evidence that anthelmintic resistance is escalating and the need for effective action is very important for the small ruminant industry.

Keywords: Anthelmintic resistance, goats

INTRODUCTION

Among the major constraints to the expansion of the small ruminant industry in Malaysia are diseases. The diseases are mainly respiratory infections and parasitic gastroenteritis which often lead to high mortality, especially in young animals. *Haemonchus contortus* or the abomasal worm is by far the most common and damaging parasite in both sheep and goats. Other than mortality from acute worm infestation, it severely debilitates the animals and reduces productivity (Ibrahim, 1996). Over the years, strongyle parasites of sheep and goats were effectively controlled by the use of anthelmintics but their frequent and indiscriminate use has led to the development of resistance in the worm population. There are several techniques for evaluating anthelmintic resistance (Coles *et. al.,* 1992) but the technique recommended for practical application is the Fecal Egg Count Reduction Test (FECRT). In FECRT, the percentage reduction in strongylid fecal egg counts following deworming is used to evaluate whether resistant worms are still present.

The emerging problem of anthelmintic resistance in strongyles of small ruminants in Malaysia has been recognised following the survey by Dorny *et al.* (1994a) that showed the presence of benzimidazole resistance in 33 out of 96 goat farms. A subsequent nationwide survey, involving 39 sheep farms and 9 goat farms, indicated that this problem had increased with high levels of resistance to benzimidazoles, levamisole, ivermectin and closantel (Chandrawathani *et al.,* 1999). Recently, resistance to four anthelmintics tested, namely oxfendazole, moxidectin and closantel, was reported in three sheep and six goat farms located in Kedah, Perak, Selangor, Terengganu and Johor (Khadijah *et al.,* 2006a ; 2006b).

In Terengganu, anthelmintic resistance in goats was reported towards benzimidazole, levamisole, ivermectin and closantel (Dorny *et al.,* 1994a; Chandrawathani *et al.,* 1999; Khadijah *et al.,* 2006a). In this study, the current status of anthelmintic resistance of strongyles in goats managed in a semi-intensive grazing system in selected farms in Terengganu was investigated.

MATERIALS AND METHODS

A total of 230 goats from six goat farms located in the districts of Marang, Kuala Berang and Setiu, Terengganu, Malaysia were chosen for this study. Two farms were selected from each district. Goats used in this study were mainly of Jamnapari, Katjang and Boer breeds and Jamnapari crosses; the Jamnapari is the most common breed in Terengganu. A total of 63 male and 169 female goats were involved. The age of the goats ranged from less than 1 year to 5 years. All farms practised a semi-intensive production system where the goats were housed in raised floor barns and allowed to graze for two hours during the day. All the farms, developed about four years ago, were owned by private farmers. The farmers have been trained by the Department of Veterinary Services (DVS) Terengganu in farm development and

*Correspondence author: Dr Rehana Abdullah Sani; Email: *rehana@vet.upm.edu.my*

management. All the farms have been observed to adopt similar management practices. Table 1 provides general information on the six goat farms involved in this study.

In this study, a total of 141 goats were subjected to FECRT. In this study, not all of the four major drug groups were tested for resistance in each farm as benzimidazole and ivermectin are the two drugs provided by the DVS to the goat farmers. Due to this provision, these two drugs were included as first priority of choice when testing for strongyle resistance. The assignment of anthelmintic treatments to each farm was dependent on the availability of goats in the farms, such that there were at least five goats per treatment. Benzimidazole and ivermectin treatments were included to be tested in each farm and in addition, levamisole and closantel treatments were included in five and two out of the six farms respectively (Table 2). All anthelmintic treatments were given according to the manufacturer's recommended dose rates.

Fecal samples were collected directly from the rectum for fecal egg count (FEC) determination using a Modified McMaster technique (Coles *et al.*, 1992). Pooled fecal culture was done for Farms 1 to 4 and infective third-stage larvae (L_3) were recovered and identified to genus level (M.A.F.F., 1986). Analysis of data to determine whether the parasite population in a particular farm was resistant, susceptible or exhibited suspected resistance was done according to the recommended protocol of Coles *et al.* (1992). Resistance to a particular drug was considered to be present based on two criteria: (1) the percentage reduction in egg count was less than 95% and (2) the 95% confidence level was less than 90%. If only one of the two criteria was met, resistance was classed as suspected. The results were reported to the DVS and farmers involved and were advised to adopt the options available for remedial action.

During sampling, questions about the farm were asked and filled in a questionnaire. A questionnaire survey of the six farms was conducted during the sampling to obtain information on farm management and health history. The detailed description of the questions included is reported in Nor-Azlina *et al.* (2011).

RESULTS

The occurrence of anthelmintic resistance in goats in this study is shown in Table 2. Farms which did not have a sufficient number of animals to test all the four drugs for resistance were indicated by NT (not tested) for those drugs. All farms tested demonstrated a high level of resistance towards benzimidazole. Goats in two farms showed susceptibility to levamisole. The resistance was acceptable for levamisole because its percentage reduction was just above 90% for all farms except Farm 5

Table 1: General information on six goat farms involved in the study

Farm No.	No. of goats	District	Breeds
1	35	Marang	Jamnapari, Boer, Katjang
2	40	Marang	Boer, Jamnapari
3	33	Kuala Berang	Jamnapari
4	41	Kuala Berang	Boer, Jamnapari crosses, Katjang
5	43	Setiu	Jamnapari, Jamnapari cross
6	38	Setiu	Jamnapari, Katjang

Table 2: Mean percentage reduction of FEC (95% upper and lower confidence limits) in six farms tested for resistance against four anthelmintics

District	Farm ID	No. of Goats	Anthelmintic type			
			Benzimidazole	Levamisole	Ivermectin	Closantel
Marang	1	15	47 (-68 to 83)	NT	15 (-152 to 71)	NT
	2	22	57 (-108 to 91)	98 (90 to 100)	81 (-47 to 98)	NT
K.Berang	3	22	20 (-144 to 73)	91 (71 to 97)	7 (-70 to 49)	NT
	4	28	28 (-548 to 92)	97 (100 to 100)	95 (80 to 99)	70 (-7962 to 100)
Setiu	5	19	92 (-5 to 99)	-117 (-2250 to 80)	13 (-820 to 86)	NT
	6	35	73 (47 to 86)	93 (74 to 98)	76 (35 to 91)	61 (-19 to 87)

NT: Not Tested

Table 3: Percentage of larval population in pre-treatment and post-treatment samples in six farms

Farm No.	L3 strongyle type	Pre-treatment (%)	Post-treatment (%)				
			Cont	Benzi	Leva	Iver	Clos
1	*Haemonchus spp.*	93	95	100	**NT**	100	**NT**
	Trichostrongylus spp.	4	3	0		0	
	Oesophagostomum spp.	3	2	0		0	
2	*Haemonchus spp.*	95	98	98	0	99	**NT**
	Trichostrongylus spp.	2	2	2	0	1	
	Oesophagostomum spp.	3	0	0	0	0	
3	*Haemonchus spp.*	95	97	100	0	97	**NT**
	Trichostrongylus spp.	5	3	0	0	2	
	Oesophagostomum spp.	0	0	0	0	1	
4	*Haemonchus spp.*	98	97	100	0	0	97
	Trichostrongylus spp.	2	3	0	0	0	3
	Oesophagostomum spp.	0	0	0	0	0	0

NT = Not Tested
Cont = Control
Benzi = Benzimidazole
Leva = Levamisole
Iver = Ivermectin
Clos = Closantel

which indicated a high level of resistance (percentage reduction = -117%). All farms had resistance to ivermectin except Farm 4 which had suspected resistance to ivermectin. Farm 4 with percentage reduction of 95% may be susceptible to ivermectin due to the percentage reduction being marginal. The rest of the farms showed varying degrees of resistance towards ivermectin. Resistance to closantel was found on two farms (4 and 6) where it was tested.

Fecal cultures indicated *Haemonchus contortus* as the main gastrointestinal strongyle parasite infecting goats in the farms as the pre-treatment samples of all six farms showed presence of 93-98% *Haemonchus* larvae (Table 3). The post-treatment samples of the four farms tested for benzimidazole showed that 98-100% of surviving larvae was *Haemonchus* larvae and 2%, *Trichostrongylus* larvae. For levamisole in the three farms which showed susceptibility or near susceptibility (as in Farm 3), the post treatment results showed absence of all strongyle larvae. Farms 1, 2 and 3 which had ivermectin resistance revealed 97-100% appearance of *Haemonchus* larvae and 1-2% *Trichostrongylus* larvae. However, Farm 4 which had marginal susceptibility to ivermectin, *Haemonchus* larvae was totally absent. Farm 4 which showed resistance to closantel had 97% *Haemonchus* larvae and 3% *Trichostrongylus* larvae. The other gastrointestinal strongyle namely *Oesophagostomum spp.* was present only in pre-treatment samples and seemed to be susceptible to all anthelmintics tested except for Farm 3 which had a presence of 1% larvae. The other strongyle, *Cooperia spp.* was not found in all fecal cultures.

DISCUSSION

This study showed two farms exhibiting susceptibility to levamisole. An analysis of the questionnaire survey revealed that levamisole was not provided by the DVS to the farmers except for Farm 5 which purchased the drug on its own. Therefore, it was highly likely that resistance towards levamisole was still minimal in goat farms in Terengganu. Ivermectin and benzimidazole resistance was at a high level which was expected due to extensive use of ivermectin and benzimidazole by the farmers who have been getting their supply from DVS, Terengganu for many years. Another factor that promotes anthelmintic resistance in Malaysia is that benzimidazole is the cheapest available anthelmintic (Chandrawathani *et al.,* 2003). Resistance towards closantel was also detected in this study. The explanation for the resistance is similar to that of levamisole where farmers purchased their own anthelmintics. This study showed that all the farms tested for benzimidazole and closantel were resistant to both drugs. A previous study in Terengganu reported resistance towards benzimidazole (Dorny *et al.,* 1994a), while closantel resistance was found later (Chandrawathani *et al.,* 1999; Khadijah *et al.,* 2006a, 2006b). In retrospect, resistance towards benzimidazole is expected as it is one of the commonest anthelmintics purchased by most small ruminant farmers in Malaysia (Chandrawathani *et al.,* 1999). Total anthelmintic resistance to oxfendazole, moxidectin, levamisole and closantel of strongyle populations in two goat and three sheep farms in Kedah, Perak, Selangor, Terengganu and

Johor have been attributed to continous exposure over a long period of time (Khadijah *et al.,* 2006a). This study supports evidence of increasing resistance to anthelmintics in goat farms in Terengganu by Dorny *et al.* (1994), Chandrawathani *et al.* (1999) and Khadijah *et al.* (2006a).

Based on fecal culture results, *Haemonchus contortus* was identified as the main gastrointestinal strongyle parasite infecting goats in the six farms as the pre-treatment samples of all six farms showed that *Haemonchus* sp larvae constituted the majority. On farms where resistance was exhibited, the majority of larvae that survived in fecal cultures was again *Haemonchus* sp. providing evidence that resistance was mainly by *Haemonchus* sp. There was also evidence of resistance of *Trichostrongylus* spp. in some benzimidazole, ivermectin and closantel groups due to the presence of the larvae in post-treatment cultures.

The future of goat production in Malaysia could be disastrous if no improvements are made to current control practices. Strategies should be designed to delay the spread of resistance and preserve the effectiveness of the available anthelmintics. To reduce dependence on anthelmintics, a grazing scheme that needs to be adopted is a pasture rotation of three to four days in each paddock and depending on the availability of paddock, pastures were 'spelled' for 30 to 35 days, a measure which significantly reduced the number of available infective larvae (Sam-Mohan *et al.,* 1995; Sani and Chandrawathani, 1996). Another approach is to totally house the animals and feed them with `cut and carry' uncontaminated grasses. Breeding approaches reduce the need for other inputs for worm treatment. Selected breeds of goats and sheep (Red Maasai, Barbados Black Belly, St. Croix, Garole sheep and East African goats) perform better in the presence of worm challenge than other breeds (Baker and Gray, 2004). Barbados Black Belly and St. Croix breeds are available in Malaysia to the farmers.

Application of the FAMACHA© system in the farms can assist in identifying anemic goats due to haemonchosis. The system ultimately reduces the number of goats that need to be drenched, thus reducing the rate of worm resistance towards anthelmintics. As an alternative to drugs, the option of feeding small ruminants with neem leaves (*Azadirachta indica*) have been reported to give promising results in small ruminant worm control (Chandrawathani *et al.,* 2002). These recommendations are aimed at effectively managing resistant worm populations and helping to alleviate the worm problem in small ruminant farms in Malaysia.

ACKNOWLEDGEMENTS

The authors thank the staff of the State Department of Veterinary Services, Terengganu, Universiti Sultan Zainal Abidin and the Parasitology Laboratory, Faculty of Veterinary Medicine, Universiti Putra Malaysia for their invaluable assistance. We also thank all the farmers who had kindly allowed their goats to be sampled for this study.

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