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An investigation of possible risk factors to anthelmintic resistance in sheep and goat farms in coastal Kenya

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ABSTRACT

Anthelmintic resistance is emerging as a serious challenge to sheep and goats rearing in many regions of the world. A study to investigate the on-farm risk factors to anthelmintic resistance in sheep and goat farms in coastal Kenya was carried out in Kilifi and Kwale counties. A total of 141 sheep and goat farmers was randomly selected and sub-locations participated in the questionnaire survey. The farm management practices relevant to helminth control were investigated and those associated with selection for anthelmintic resistance identified.The results showed that the commonly used classes of anthelmintic were levamisoles and benzimdazoles with only a very small minority making use of avermectins. The prevalent risk factors identified from this study included under-dosing, dry season treatments, lack of quarantine drenching of newly purchased animals, and use of clean pasture grazing after treatment. A more focused approach is recommended for dissemination of appropriate helminth control practices that can help slow the development of drug resistance as well as further research to understand the relationship between these factors and the rate of resistance development in other production systems.

Keywords: Sheep, goats, anthelmintic resistance, gastrointestinal nematodes, risk factors

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INTRODUCTION

The over-reliance on use of anthelmintics for the control of gastrointestinal helminthes has led to farmers, veterinarians and other livestock health providers with divergent information and recommendations for responsible and effective use of these drugs (Patten et al., 2011). Some of these recommendations included the use of some management options like pasture rotation, moving treated animals to new pastures as well as alternate grazing. Some of these methods had demonstrated some production benefits including overall wool production (Carbaret et al., 2002) and lamb growth by 10-20% prior to weaning (Muenstermann and Tome, 1989; Waller, 2006) as well as prolonging the usefulness of anthelmintics compounds. A number of the practices have since been shown to select heavily for resistance with survivors of treatment reseeding clean pastures rapidly (Coles, 2002). Some service providers are still advocating them while their contribution to the observed incidences of Anthelmintic resistance has not been well documented.

A survey carried out on the quality of marketed anthelmintics drugs in Kenya showed that majority of the products were within the recommended range (Nginyi et al., 2013). Only a few products were found to be outside of this range. It is, therefore, possible that much of the observed cases of resistance are accounted for by other management factors such as frequent drenching and underdosing, other than drug quality.

This study was aimed at investigating the existing management factors in sheep and goat farms at the

Table 1: The seasons of the year when farmers experienced most helminth problems in their flocks and when they instituted anthelmintic control. The percentages are shown in parenthesis.

Season	Number of farmers who experience helminth problems (%)	Number of farmers who institute control measures (%)
Wet	81 (60.0)	74 (54)
Dry	31 (23)	26 (19)
All year round	9 (6.5)	17 (12.4)
Don't know	14 (9.9)	6 (10.2)
As need for treatment arises		14 (4.4)

coastal region where anthelmintic resistance was observed in earlier studies (Mwamachi et al., 1987; Wanyangu et al., 1996; Nginyi et al., 2007) and identify those that are likely to be contributing to resistance. This information is necessary to develop evidence-based recommendations in helminth control in sheep and goat farms in the region.

MATERIALS AND METHODS

This study was carried out in June 2013 and involved a total of 141 smallholder sheep and goat farms in Kilifi and Kwale counties at the coastal region of Kenya. The participating farms were randomly selected from sampling frames provided by the local extension officers in the two counties. These were from the randomly selected sub-locations in each county and these formed the sampling clusters. The questionnaires captured different aspects of animal husbandry which includes grazing systems, feeding, helminth control practices (including drugs used, frequency, rotation, timing of the drenching, dose determination, criteria for a drug of choice, etc.). These were the factors among the hypothesis that leads to the development of anthelmintic resistance.

RESULTS

Respondents

A total of 141 farms participated in this study, out of which 80 (56.7%) were household heads and the rest other close relatives of the household heads. There were 83 male (58.8%) and 61 (43.2%) female respondents. The level of education amongst all the respondents ranged from primary (45.7%), secondary (17.4%), tertiary (4.3%) and university (2.2%). A total of 42 (30.4%) of the respondents did not have any formal education. Land sizes ranged from 0.25 to 20 acres with only a minority (3.6%) having more than 20.

Management practices amongst sheep and goats farms

Out of the 141 farmers who participated in the study, 138 or 97.8% kept sheep and goats. Majority had less than 20 sheep/goats per homestead with 51 (37.2%) with one to five, 69 (50.4%) with 6-15 and 12 (12.9%) 2 with 6-40. Those who had sheep kept less than 15 per farm with 66.7% with less than five and 27.8% with five and fewer per farm.

Veterinary care for sheep and goats was provided mainly by animal health assistants (26.7%), veterinary officers (20.7%) and community based-animal health workers (19.3%). Others who provided this care included farmers themselves, relatives and agro-vet shop owners (33.3%). The drugs used for the animal treatments were supplied mainly by agro-vet shops (65.5%), other animal health service providers (23.4%) and non-governmental organizations (6.7%), while 5.2% came from other sources

Use of anthelmintics

Majority of the farmers interviewed (129 or 91.5%) had used anthelmintics in the treatment of helminth infections in their flocks in the previous 12 months while 12 (8.5%) had not used them. Among the 129 farmers who had used anthelmintics, majority dewormed their animals three times a year (40.3%). The rest used them once (14.5%), twice (27.4%), four (11.3%), five (0.8%), six (0.8%) and 12 times (0.8%) a year. Four farms (3.2%) only used anthelmintics when their animals appeared clinically sick from helminthoses.

Majority of the farms used levamisole-based (33%) and benzimidazole-based (34%) drugs while only 0.8% used ivermectins. A proportion of the farmers (23.7%) could not recall the names of the drugs they last used. Table 1 shows the times of the year farmers experienced most cases of helminth problems and when they drenched their animals.

While determining the weights of animals, the majority (98 or 70.0%) used visual appraisal and only five (3.6%) used a weighing scale. Overall, only 49 (38%) used the weights in determining the dose of anthelmintics given to their animals and only 41.9% realized that it was important to rotate the different anthelmintic classes. For those who rotated the classes of drugs, the frequencies of the rotations are shown in Table 2.

The other helminth control practices amongst the interviewed farmers are as summarised in Table 3.

Table 2: Frequency of drug rotations amongst sheep and goat farms in Kilifi and Kwale counties.

Frequency of drug rotation in months	Number of farmers	Percentage
1-6	10	8.6
7-12	25	21.6
13-18	43	37.1
Don't rotate	3	2.6
When one drug fails	2	1.7

Table 3: Other management practices relevant to helminth control amongst sheep and goat farms in Kilifi and Kwale counties.

Helminth control practice	Number of farmers	Percentage
Moving treated animals to clean pasture	71	55.0
Purchase of animals from outside their farms	61	43.9
Purchased animals from outside kept away from flock for a while	16	18.2
Drenching newly bought animals before mixing with old stock	20	27.0
Use of same dose for sheep and goats	24	34.3
Drenching entire flocks	107	82.3
Use of injectable anthelmintics	39	31.7
Experienced treatment failure after use of anthelmintics	31	25.6

Table 4: The number and percentage of farmers who administer anthelmintics at different times of the day to their sheep and goats in Kilifi and Kwale counties.

Time	Number of farmers	Percentage
Morning	105	82.7
Evening	12	9.4
Morning and evening	2	1.6
Morning and mid-day	1	0.8
No specific time	4	3.2

The equipment used in drenching animals ranged from syringes (76.6%), drenching guns (4.0%), spoons (4.0%), bottles (1.6%), cups (1.6) and other calibrated containers (1.6%). Table 4 shows the times of the day when the farmers administered anthelmintics to their flocks.

Of the 31 farmers who had experienced treatment failure following use of anthelmintics, the classes of drugs involved were levamisoles (29.3%) and benzimidazoles (14.6%). There was no record of failure for the few who had used avermectins.

DISCUSSIONS AND CONCLUSIONS

The results of this study showed that the majority of sheep and goat farmers relied on anthelmintics for the control of gastrointestinal helminths in their flocks. This is similar to the situation in many other areas of Kenya (Maingi et al., 1993; Kinoti et al., 1994; Mbaria et al., 1995). Result from this study demonstrated that the over majority of the respondents had used these drugs on their flocks in the previous 12 months. The study also showed that levamisole and benzimidazole drugs were the classes used by a majority of the farmers. This could be due to the fact that the majority of these formulations are available in liquid/suspension forms which are easier to handle as opposed to the injectable forms in which the ivermectin drugs are available. The fact that the farmers administered these drugs themselves could support these as injectable forms might require the involvement of a professional animal health attendant.

Previous studies on farms in the coastal area had indicated that resistance to anthelmintics was prevalent to all the common classes of drugs (Mwamachi et al., 1987; Wanyangu et al., 1996; Nginyi et al., 2007). The possible factors that could have led to this situation were not fully investigated though frequent use of drugs and the possible existence of poor quality drugs was suspected (Wanyangu et al., 1996; Monteiro et al., 1998; Nginyi et al., 2013). A more recent study examined the quality of marked anthelmintic products in the country, including the coastal area and showed that only a small proportion of these products was sub-standard (Nginyi et al., 2013). It was therefore likely that on-farm factors could be contributing more to the observed resistance to

anthelmintics in this region and even to other parts of the country. This study explored some of the on-farm factors that are considered critical in the development of anthelmintic resistance.

The risk from underdosing amongst the sheep and goat farmers was evident from the fact that a majority did not weigh their animals to determine their weights. The use of visual appraisal was the most common and some did not use weight to decide on the dose of the drug. Similarly, some farmers used un-calibrated containers to administer the anthelmintics and this could have resulted in instances of either under-dosing or over-dosing.

Whereas the frequency of anthelmintic treatment was not high for the majority of the farmers, a proportion of them practiced dry season treatment and moved their animals to different pastures after treatment. Both these practices are known to hasten the development of resistance as the treatments are administered during times when the level of worms *in refugia* was low (Leathwick et al., 1995; Van, 2001; Falzon et al., 2013). The practice exerts high selection pressure as the parasites surviving the treatments contribute almost the entire generation of nematodes contaminating the pasture. These are resistant to the selecting class or classes of anthelmintics.

The practice of mixing newly purchased animals with existing flock without quarantine treatment could be responsible for introducing drug resistance to farms where this did not exist. This was the case with a majority of the farmers in the study area. The fact that purchased breeding stock could be coming from large-scale farms, where drug use frequency and anthelmintic resistance could have set in, only made matters worse for the farms involved.

The results of this study indicated that some of the management practices in the sheep and goat farms could be responsible for the observed incidences of anthelmintic resistance. These risk factors included under-dosing, dry season drenching, use of safe pastures and lack of quarantine treatment for newly purchased animals. The farmers need to be trained on the best practices in the management of gastrointestinal helminth infections in their flocks. Appropriate approaches in the dissemination of such extension messages need to take into account the literacy levels of majority of the farmers that might not benefit from the conventional methods used in the past. Use of mass media as well as local FM radio stations to deliver the messages might be more appropriate. A further suggestion is the use of the FAMACHA chart to identify sheep and goats that needed treatment instead of deworming entire flocks. It is also suggested that further work to determine the role of the above risk factors in the other regions and in different farming systems in drug resistance be carried out to develop a better data derived helminth control packages for farmers.

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