THE EFFICACY OF ALBENDAZOLE AND MOXIDECTIN IN THE CONTROL OF NEMATODE INFECTION IN DAIRY CATTLE

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Abstract

The objective of this randomized controlled field trial was to determine and compare the efficacies of two anthelmintics, moxidectin and albendazole on gastrointestinal nematodes (GIN) in smallholder dairy cattle in Kenya in June to August 2010. On the first visit, faecal samples were collected from the rectum of 419 cattle that were above three months of age on 128 smallholder dairy farms. Faecal egg counts (FECs) for GIN eggs were conducted using the modified McMaster method, and larval cultures were done on pooled samples for each farm to determine the GIN genera encountered. The cattle were allocated to three treatments groups (albendazole, moxidectin, and placebo groups), using a blocked random allocation method. A second faecal sampling and FEC was done on the recruited cattle two weeks post-treatment, with laboratory staff again blinded to each sample's group status. Statistical analyses were conducted to determine the efficacies of the two anthelmintics mentioned relative to the placebo group. The prevalence of GIN infections in the study population was 13.8%, in large part due to 75% of the cattle being managed using zero-grazing. Haemonchus, Trichostrongylus and Oesophagostomum were found on 28%, 20% and 15% of the 128 farms, respectively. The newer moxidectin had significantly better efficacy (95.8%) than albendazole (74.9%) for treating GINs in smallholder dairy cattle in Kenya.

Key Words: Albendazole, Moxidectin, small holder dairy cattle, Nakuru District, Mukurweini District.

L'EFFICACITE DE L'ALBENDAZOLE ET DE LA MOXIDECTINE DANS LE CONTROLE DE L'INFECTION AUX NEMATODES CHEZ LES BOVINS LAITIERS

Résumé

L'objectif de cet essai contrôlé randomisé sur site était de déterminer et de comparer les niveaux d'efficacité de deux anthelminthiques, la moxidectine et l'albendazole, sur les nématodes gastro-intestinaux (NGI) chez les bovins laitiers des petites exploitations au Kenya, de juin à août 2010. À la première visite, sur 128 petites fermes laitières, des échantillons fécaux ont été prélevés dans le rectum de 419 bovins âgés de plus de trois mois. Une numération des œufs fécaux (FEC), pour les œufs GIN, a été effectuée selon la méthode modifiée de McMaster, et des cultures larvaires ont été réalisées sur des échantillons groupés pour chaque exploitation, afin de déterminer les genres GIN identifiés. Les animaux ont été répartis en trois groupes de traitement (albendazole, moxidectine, et groupe sous placebo) en utilisant une méthode de répartition aléatoire. Un deuxième prélèvement fécal et une FEC ont été effectués sur des bovins sélectionnés deux semaines après le traitement, le personnel de laboratoire étant laissé aveugle quant à l'état du groupe de chaque échantillon. Des analyses statistiques ont été réalisées pour déterminer les niveaux d'efficacité des deux anthelminthiques susmentionnés par rapport au groupe sous placebo. La prévalence des infections GIN chez la population étudiée était de 13,8%, en grande partie dû au fait que 75% les bovins étaient gérés en stabulation. Les nématodes

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Haemonchus, Trichostrongylus et Oesophagostomum ont été trouvés respectivement dans 28%, 20% et 15% des 128 fermes laitières. La nouvelle moxidectine avait une efficacité significativement meilleure (95,8%) que celle de l'albendazole (74,9%) pour le traitement de GI chez les bovins laitiers des petites exploitations laitières au Kenya.

Mots-clés : Albendazole, Moxidectine, bovins laitiers des petits fermiers, District de Nakuru, District de Mukurweini.

Introduction

The use of anthelmintics in cattle has reduced the impacts of gastrointestinal nematodes (GIN) on productivity. However, their frequent use and under-dosing have contributed to the emergence of nematode populations resistant to the drugs available in the market (Michel, 1985). Therefore, randomized controlled field trials to determine their efficacy are needed to assist veterinarians and farmers in decisions on which anthelmintic products should be used.

Albendazole, a benzimidazole derivative, is an anthelmintic drug that has been widely used around the world against nematodes for decades, with the specific advantage of being effective against round worms, tapeworms and flukes both in cattle and small ruminants (Guitian *et al.* 1999). According to Maingi *et al.,* (1998), the most commonly used anthelmintics in Kenya are benzimidazoles and levamisoles. Studies carried out in Nyahururu District of Kenya confirmed the presence of resistance to albendazole and levamisole in sheep (Maingi *et al.,* 2001). It is thus possible that resistance to albendazole in cattle could have also developed. Studies done in Argentina using benzimidazoles indicated faecal egg count (FEC) reductions of 68% in cattle compared with the expected 95% that would demonstrate good anthelmintic efficacy (Suarez *et al.,* 2006). Moxidectin (pour-on) is a relatively new anthelmintic to African cattle farmers with a very wide safety margin (Kahn & Line, 2010). A study carried out in Mexico by Maritonera-Diez *et al.,* (2005) showed the efficacy of moxidectin pour- on to be 100% at day 28, dropping to 33% at day 60. The current study was meant to determine the efficacy of moxidectin pour-on compared with oral albendazole on smallholder dairy farms in Kenya.

Material and Methods

Study area

The trial was carried out in Mukurweini District of Nyeri County and Nakuru District of Nakuru County in Kenya. Nyeri County is one of the five counties of Central Province and forms part of Kenya's central highlands (Ministry of Planning and National Development, 2005). Dairy farming is an important enterprise in Mukurweini District, with the farmers practicing zero-grazing methods, where pastures are cut and carried to the cattle (Ministry of Livestock Development, 2008).

Nakuru County is one of the 14 Counties of the Rift Valley Province (The Constitution of Kenya, 2010), and lies within the Great Rift Valley. Dairy farmers in the area practice both zero-grazing, and semi-zero-grazing, where the cattle are housed but allowed to graze at certain times (Ministry of Livestock Development, 2008).

Study design

A total of 419 head of cattle on 128 smallholder farms (64 from each district) were enrolled to the field trial. In Nakuru, a simple random selection was employed at the farm level using a sampling frame of the dairy farms provided by the District Livestock Production Officer. For logistical reasons, a purposive sampling method was used in Mukurweini, as the research was conducted alongside another project comparing smallholder dairy farms with and without biogas digesters (Dohoo *et al.,* 2012a; Dohoo *et al.,* 2012b). In Mukurweini district, all cattle that were above three months of age on the selected farms were sampled for the study. In Nakuru district, some farms were larger, and therefore on farms that had large herds of cattle, the animals were systematically randomly selected, such that no more than 10 animals were sampled per farm.

The study was carried out between 16th June 2010 and 30th August 2010. On the first visit (day 0), faecal samples (minimum of 5 g) from each selected animal were collected from the rectum. They were examined for nematode eggs at the parasitology laboratory at the Faculty of Veterinary Medicine, University of Nairobi Kabete. Faecal egg counts (FEC) of GIN eggs were conducted using the Modified McMaster technique (Wood *et al.,* 1995). Animal owners and laboratory staff were blinded to the treatment groups of the animals.

Sampled cattle were randomly allocated into one of the three groups. This was done by a random block allocation method, with the first treatment being picked randomly by selecting numbers from a hat without replacement until all numbers were selected.

- Group 1 – control group, only oral and pour-on placebos
- Group 2 – moxidectin 0.5% pour-on at 0.5 mg/kg body weight (licensed dose) poured along the dorsal midline of the animal, and an oral placebo.
- Group 3 – albendazole drench at 10 mg/kg body weight (licensed dose) and a pour-on placebo.

Because treatment with albendazole comes with a warning not to use on cows/ heifers pregnant less than 45 days or on milking cows (milk withdrawal), milk cows and bred heifers were only allocated to groups 1 or 2. A second faecal sampling and FEC was done on the recruited cattle two weeks post-treatment, with laboratory staff again blinded to each sample's group status.

Data handling and Statistical Analysis

The anthelmintic efficacy (%) post-treatment for each of the anthelmintic medicines was estimated according to Wood *et al.,* (1995): % Efficacy = ((Mean FEC Control – Mean FEC Treatment) / (Mean FEC Control)) * 100. The formula uses the post-treatment FECs assuming that the pre-treatment FECs are the same due to the random allocation of animals in the groups. Arithmetic mean was used as opposed to geometric mean, as the geometric means tend to overestimate drug efficacies, and thus, are unable to pick up small levels of anthelmintic resistance (Waruiru *et al.,* 2003). The 95% confidence intervals were calculated around the efficacy percentages.

Results

For the two visits, the sample numbers, and mean FECs of the 3 treatment groups are presented in Table 1. On the first visit, the prevalence of GIN infections in the study population was 13.8%, in large part due to 75% of the cattle being managed using zero-grazing. There were no differences in mean FECs among groups on the first visit, as expected, demonstrating an effective random allocation process. *Haemonchus*, *Trichostrongylus* and *Oesophagostomum* were found on 28%, 20% and 15% of the 128 farms, respectively.

On the second visit, 2 of the 419 enrolled animals were not sampled and tested by FEC because they were not at the farm at the time of the visit. The mean FEC was significantly higher in the placebo and albendazole groups compared with the moxidectin group, while the albendazole-treated animals had a numerically but not statistically significantly lower FEC than the animals in the placebo group (Table 1). The moxidectin group had a significantly higher efficacy (95.8%) than the albendazole group (74.9%).

Discussion

In this randomized controlled, blinded, field trial, moxidectin pour-on had an efficacy of 95.8%, which is slightly lower than a study that was carried out in Mexico by Maritorena-Diez *et al.,* (2005), which placed the efficacy of moxidectin pour-on at 100% after 28 days. Compared with the expected 95% that would demonstrate good anthelmintic efficacy, this relatively new anthelmintic to the African marketplace appears to have very good efficacy against GINs in cattle in Kenya. However, because moxidectin does not work against trematodes, cattle at risk of trematode infection should be dewormed periodically with an anthelmintic with theoretical or known efficacy against trematodes, such as albendazole. This study did not assess the efficacy of albendazole on trematodes.

Table 1. Number of cattle allocated to the anthelmintic treatment, the mean epg count 14 days post treatment and the 95% confidence interval.

Treatment Group	Number Sampled	Mean FEC [95% CI][1]	Percentage efficacy [95% CI]
Placebo	180	13.3 [6.5, 20.1]	-
Moxidectin	179	0.56 [0, 3.2]	95.8% [93.7, 97.9]
Albendazole	60	3.3 [0, 7.9]	74.9% [69.0, 80.8]

1 FEC = Faecal egg count; CI = confidence interval

Albendazole had an efficacy below 80% in the current study, which may be partly because it has been in use for a long time as the drug of choice for dairy farmers in Kenya, who buy the anthelmintic over the counter (Wanyangu *et al.,* 1994). A study carried out in Nyandarua (Maingi *et al.,* 2001) reported resistance to benzimidazoles in sheep. However, another study carried out on goats in Kenya by Waruiru *et al.* (2003) estimated the efficacy of albendazole at 96.9% at day 21. Our efficacy percentage (74.9%) was similar to another benzimidazole study done in Argentina, which had an efficacy of 68% (Suarez *et al.,* 2006). Perhaps there is less albendazole resistance among goats in Kenya than among cattle.

Benzimidazoles are sold over the counter under many varying brand names by different manufacturers, which lead the farmers to think they are switching anthelmintics (Wanyangu *et al.,* 1994), which could have contributed to resistance over time.

Conclusions

Moxidectin had a very good GIN efficacy in cattle in Kenya, and had a higher efficacy compared with albendazole Farmers should be encouraged to use a variety of anthelmintic drugs, in rotation, including moxidectin, to ensure proper GIN control, in consultation with their local veterinary service providers.

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