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Building a combined targeted selective treatment scheme against gastrointestinal nematodes in tropical goats☆

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ABSTRACT

The design and validation of a combined targeted selective treatment (C-TST) scheme to control gastrointestinal nematodes (GIN) of goats under tropical conditions is described. A survey performed on 1585 goats (older than 4 months) from 103 smallholder subsistence farms from tropical México (Yucatán), showed the classical over-dispersion distribution of the GIN fecal egg excretions (FEC) indicating that most goats had a low excretion of eggs and only a few had high FEC. A second stage of the survey (20 farms) tested the association between FAMACHA© and packed cell volume (PCV) ($n = 638$) as well as FAMACHA© and FEC ($n = 627$). The survey showed that FAMACHA© was a good tool to identify anemic animals but no association was found with their FEC. As a result, we proposed to combine FAMACHA© with body condition score (BCS) to identify adult animals at risk of high GIN infections. The FEC was used to identify goats needing anthelmintic (AH) treatment. The C-TST scheme was surveyed in a goat farm (mean 138 adult goats/year) in Yucatán for 6 years (8292 events recorded). In that period, the mean number of goats left without AH treatment was 57.4%. Meanwhile, nearly 30% of the goats needed only one treatment per year. Less than 15% of the goats required 2 or more treatments per year. Besides, the AH doses were distributed amongst small number of animals every month throughout the year. Thus, under the browsing conditions of Yucatán, México, the combination of BCS and FAMACHA© can be used as a screening procedure to identify animals at risk of severe GIN infections and the FEC help to reduce the number of goats treated per year with no apparent negative consequences on the goats.

1. Introduction

Targeted selective treatment (TST) is a general approach aiming at reducing the frequency of anthelmintic (AH) treatments against gastrointestinal nematodes (GIN). The TST schemes represent a change in the way conventional AH drugs are used. Rather than treating all the animals in a group or herd, the TST aims at identifying only those highly infected animals that require an AH treatment, in order to prevent negative consequences on health,

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welfare or production, while all other animals remain without AH treatment (Van Wyk et al., 2006; Kenyon et al., 2009). The TST schemes have two main interests: (a) maintaining refugia of susceptible parasite populations within a farm (herd) and (b) reducing the costs of AH treatments by reducing the use of drugs. The main limitation of any TST scheme remains to be the difficulty of identifying those animals that are not coping with worm challenge. For nearly a decade, only FAMACHA© score and body condition score (BCS) have been regarded as being of practical value or having potential for repeatedly examining herds and identifying individuals for AH treatment (Van Wyk and Bath, 2002). However, both methodologies have limitations when applied to adult goats even under conditions where *Haemonchus contortus* is abundant: (i) the sensitivity of FAMACHA© scores 4, 5 to detect anemia in goats is low (23–31%; Vatta et al., 2002a), (ii) anemia can be caused by many factors (Van Wyk and Bath, 2002), (iii) BCS is also influenced by several management and health aspects other than GIN infections (Vatta et al., 2002b). It has been suggested that the combination of FAMACHA© and BCS, which can be applied simultaneously to a given flock, may achieve the full potential of clinical evaluation for haematophagous and non-haematophagous GIN infections (Van Wyk and Bath, 2002). We propose to use FAMACHA© and BCS to find adult goats at risk of severe GIN infections. Rather than treating animals according to those indicators, we propose to use FEC as a correction factor leading to treat anemic/emaciated goats that have a certain threshold of worm eggs. Such combination of techniques is described here as combined TST (C-TST). However, before any TST scheme is suggested, the distribution of FEC must be investigated in the goat population in the area of interest (Hoste et al., 2001). Also, FAMACHA© must be validated before it can be used for goats in a given region (Kaplan et al., 2004; Ejlertsen et al., 2006; Mahieu et al., 2007; Scheuerle et al., 2010). The first objective was to describe the distribution of nematode egg counts in 1500 browsing goats from 103 smallholder herds and its implications for helminth control. The second objective was to evaluate FAMACHA© as a tool to identify anemic or parasitized goats in 638 animals from 20 smallholder flocks. The third objective was to determine the number of animals requiring AH treatment per year in a goat farm using the C-TST based on FAMACHA©, BCS and FEC measurements.

2. Materials and methods

2.1. Distribution of nematode fecal eggs output in naturally infected goats

A survey was performed in Yucatán, México (20°52′–19°30′ N and 90°00′–88°50′ W) during the wet season (from July to September). The climate of the area is hot and humid with summer rainfalls. The total rainfall recorded in the study area during the survey was ~530 mm. The maximum ambient temperature varied from 39 °C in June to 36 °C in September and minimum temperature between 25 °C in June and 20 °C in September. The vegetation of Yucatán is a tropical forest with mainly deciduous vegetation to the north and perennial vegetation to the south (Flores-Guido and Espejel-Carvajal, 1994). All the herds belonged to subsistence farmers using native vegetation as the main source of nutrients for their animals. Animals browsed during the day (4–8 h per day) and were kept indoors during the afternoon and night, when supplementary feeding was provided in most cases. The goats were mainly Criollo with scarce influence of Nubian, Alpine or Saanen breeds and were kept mainly for their milk and the kids.

This survey examined the GIN fecal egg count (FEC) of all the goats older than 4 months of age from 103 smallholder flocks ($n = 1500$ goats). Goats of the different farms were grouped by age according to observations of their front teeth: Group 1 (older than four months but younger than 1 year), Group 2 (older than 1 but younger than 2 years), Group 3 (older than 2 but younger than 3 years), Group 4 (older than 3 but younger than 4 years), and Group 5 (older than 4 years). The farmers reported that animals were not de-wormed at least in the three months before the fecal samples were taken in their respective herd.

2.2. Evaluation of FAMACHA© in goats from tropical México (Yucatán)

A total of 638 goats (older than 4 months of age) from 20 goat flocks surveyed were also used to evaluate the association between the FAMACHA© scores (Van Wyk and Bath, 2002), the FEC and the PCV. These three variables were determined in these goats as described below.

2.3. Sample collection and processing in the surveys

Blood samples were obtained from the jugular vein of each animal using needles and EDTA test tubes for each animal. Individual fecal samples were obtained from all the goats. Samples were maintained in refrigeration before processing. Animals were examined to determine their FAMACHA© score as suggested by Bath et al. (2001). The same two trained persons scored all the animals. The blood samples were processed between 2 and 4 h after collection using the micro-hematocrit technique. The feces were processed individually by using a modified McMaster method with an average detection level of 50 eggs per gram (EPG) of feces (Rodríguez-Vivas and Cob-Galera, 2005). The feces were used to produce bulk fecal cultures for most herds and were kept in an incubator at 27 °C for five days. On day 6 the infective larvae were harvested and were also identified (~50 larvae per coproculture) using the keys of identification for ruminant nematodes (MAFF, 1986; Bowman and Lynn, 1999). In total the survey included 81 coprocultures from the different flocks.

2.4. Implementing the C-TST combining FAMACHA©, body condition score and FEC

The C-TST scheme was tested at the FMVZ-UADY goat farm in Mérida, Yucatán, México (20°52′ N and 89°37′ W), from 2005 to 2010. The farm had an average of 138 adult female Criollo goats per year, browsing in ~20 ha of nearby low deciduous tropical forest. Goats browsed daily during the morning and were kept indoors overnight where they received their daily supplement (~200 g/animal/day; 74:26 sorghum meal:soybean meal). Parturition intervals of the female goats' were between 8 and 9 months and the average litter size was 1.7 kids with an average weight of 2.1 kg per kid. Milk was used mainly to feed growing kids in the flock.

Every 30 days, all the adult female goats were examined to determine their FAMACHA© score (as previously described) and their BCS with the methodology for tropical goats (Honhold et al., 1989). If individual FAMACHA© and/or BCS crossed below a certain threshold (see Fig. 1) a fecal sample was obtained directly from the rectum of the animal. Fecal samples were processed immediately after collection to determine the EPG as described above. On the year 2005, the threshold to decide AH treatment was 500 EPG. After that year, the threshold used to decide AH treatment was 750 EPG. Animals needing AH treatments were injected with levamisole (12 mg/kg subcutaneous route). All the other animals in the herd remained untreated with AH. The FAMACHA© and BCS score were determined by the same two persons during 2005 and, after one year, one of the trained staff did all the FAMACHA© and BCS scoring/recording. The staff recorded the following monthly events: individual identifications of animals, their BCS and FAMACHA© scores. Animals that were sampled (feces) were also recorded together with their McMaster results. Data was stored in a data-base using Microsoft Excel 2003 and 2007.

2.5. Data processing and statistical analyses

2.5.1. Distribution of nematode fecal eggs output in naturally infected goats

Means, variance, minimum and maximum values were calculated for the EPG and PCV data of the total number of surveyed goats and also for each age group (1, 2, 3, 4 and 5) using the PROC Univariate of SAS (Cody