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Short communication

Evaluation of a targeted selective treatment scheme to control gastrointestinal nematodes of hair sheep under hot humid tropical conditions

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1. Introduction

The control of gastrointestinal nematodes (GIN) in sheep flocks is currently based on the frequent use of commercial anthelmintic (AH) drugs. Emergence and expansion of anthelmintic resistant GIN populations (Torres-Acosta et al., 2012a) resulted in the search of alternative control strategies aiming to reduce the current dependency on AH drugs, or making a more efficient use of AH (Amarante, 2014). Targeted selective treatment (TST) schemes aim at identifying individuals within a flock needing an AH treatment and is based on different criteria such as presence of indicators like diarrhoea, body condition score (BCS), presence of anaemia (FAMACHA© system) and eggs per gram of faeces (EPG) (Gallidis et al., 2009; Ouzir et al., 2011; Papadopoulos et al., 2013). FAMACHA© and BCS are considered the most practical way for repeatedly examining herds and identifying individuals for AH treatment (van Wyk and Bath, 2002; Bath and van Wyk, 2009). However, under the field conditions of tropical Mexico, animals show signs of anaemia and low BCS resulting mainly from the low quantity and quality of the diet harvested in the field and the constant reproductive activity, with parturitions every 8 or 9 months, while the effect of GIN seems less important (Torres-Acosta et al., 2012b). In recent years, the combined use of BCS, FAMACHA© and EPG has been proposed as criteria to support the decision to deworm goats under tropical conditions of México (Torres-Acosta et al., 2014). Under such TST scheme, only adult animals with poor BCS (1 or 2) or poor FAMACHA© (4 and 5) are faecal sampled and the AH is only applied to those animals with ≥750 EPG. Such value was reached by less than 25% of the goat population originally evaluated. The strategy was tested with different EPG levels in goats. That EPG level was recently validated in sheep in the hot sub-humid tropical forest of Mexico (González-Ruiz et al., 2012; Soto-Barrientos, 2012). The TST scheme, performed on the adult females of the herd or flock on a monthly basis, helped reducing unnecessary treatments

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of sheep by 68.10–76.40%, and in goats by 54.4%. Females under such TST scheme did not show negative effects on their health status or productivity. It is important to confirm whether this TST scheme can be used under warm humid conditions, particularly during the rainy season, when a dangerous GIN challenge is expected. This study estimated the frequency of anthelmintic (AH) treatments in sheep from commercial flocks using a targeted selective treatment scheme based on FAMACHA©, body condition score (BCS) and faecal egg counts (FEC) in a hot and humid tropical area.

2. Materials and methods

2.1. Study site

Four sheep farms were surveyed. These were located in the Centro, Sierra and Chontalpa regions of Tabasco state, México. Predominant climate in the whole zone is warm-humid with year-round rainfall (Af). The study was developed during the rainy season (June–December, 2013). Mean monthly rainfall recorded during the period was 243.9 mm (343.7–187.8) for farms R1 and R3 located in Centro region, 269.72 mm (362.4–193.3) for farm R2 on Sierra region and 227.9 mm (299.8–138.8) for farm R4 on Chontalpa region. Mean temperature was 32.3 °C (33.4–30) in Centro region, 27.7 °C (28.3–25.8) in Sierra region and 22.9 °C (23.6–21.5) in Chontalpa region (SMN, 2013).

2.2. Characteristics of farms and sheep included in the survey

Sheep farms included in the survey had at least 100 adult hair sheep females. Predominant breeds were Pelibuey, Blackbelly and their crosses. Ewes included were adult, >1 year old and at different reproductive stages (i.e., pregnant, lactating, etc.). Different groups of ewes were in different mating groups year-round. Thus lambings were distributed during the study period in different groups. Study flocks were previously diagnosed with multi-resistant GIN strains to the three main AH family drugs (Herrera-Manzanilla et al., 2013). The production systems were based on diurnal grazing with eight to ten hours of grazing and nocturnal indoor housing. The grass species in the paddocks were *Panicum maximum cv. tanzania*, *Cynodon plectostachyus*, *Paspalum notatum*, *Brachiaria decumbens* and *Brachiaria brizantha*. Animals in all the flocks received different amounts of commercial feed when they returned from the grazing. Flocks with better supplementation tended to show better mean FAMACHA© and BCS scores.

2.3. Distribution of GIN faecal eggs in the survey flocks

Before the implementation of the TST scheme, 401 ewes were individually examined (75–119 ewes in each farm), in the four farms. An individual faecal sample was obtained directly from the rectum of all ewes evaluated to determine the excretion of GIN eggs per gram of faeces (EPG) using a modified McMaster technique (Rodríguez-Vivas and Cob-Galera, 2005). The same sampling procedure was performed on 431 ewes at the end of the six-month period, (65–151 ewes in each farm). This procedure determined the effect of the TST scheme on the distribution of EPG excretion at the end of the study period. The examination included the evaluation of the colour of palpebral mucosae using the FAMACHA© chart technique (1–5 score) (van Wyk and Bath, 2002) and the body condition score (BCS) (Russel, 1984), where 1 corresponded to emaciated ewes and 5 to overfed ewes.

2.4. Implementation of the TST scheme in the surveyed farms

A total of 981 ewes were included (from 94 to 335 sheep in each farm). Farms were visited every 14 days and all ewes were individually examined to determine their FAMACHA© score and their BCS. The following criteria were used to decide when to take a faecal sample from ewes:

a) FAMACHA© 1, 2, 3 and BCS > 2: No faecal sample was taken and sheep were not dewormed.
b) FAMACHA© 1, 2, 3 and BCS ≤ 2: Faecal sample was taken and body weight determined.
c) FAMACHA© 4 and 5: A faecal sample was taken and the body weight determined.

Faecal samples were used to determine the EPG. Those ewes with an excretion ≥50 EPG were treated as such EPG level has been used safely in previous TST trials in Mexico. Treatments were performed with a combination of ivermectin (0.2 mg/Kg BW) and levamisole (7.5 mg/Kg BW), subcutaneously. This combination showed a mean reduction above 83% in all the surveyed flocks according to FERCT methodology (Coles et al., 1992).

2.5. Statistical analysis

The distribution of nematode EPG in naturally infected ewes was estimated before and after the application of the TST scheme in surveyed farms. The frequency of animals positive to EPG was calculated with the formula: Frequency = Number of ewes positive to FEC/total number of ewes surveyed per farm. The mean EPG excretion (±standard deviation), the median, the minimum and maximum values and skewness of the EPG data were determined using the PROC Univariate statistical package SAS 9.0®. Skewness was determined to compare the similarity of the EPG data distribution with the normal distribution model. Proportions of animals excreting ≥750 EPG and ≥1000 EPG were also determined for each farm. The association between EPG and FAMACHA©, EPG and BCS of each ewe in the respective farm was calculated with Spearman correlations using the SAS 9.0® statistical package (SAS Institute Inc., 2002).

The TST scheme in the four surveyed sheep farms was evaluated by calculate (total and percentage) of: (a) Ewes assessed by the TST scheme in period, (b) Events assessed by the TST scheme in the period, where each ewe contributed with 1–12 events, (c) Events showing FAMACHA© 4 or 5, (d) Events with BCS 1 or 2, (e) Faecal sampling events, and (f) Deworming events (EPG ≥ 750), (g) Frequencies of ewes treated with AH drugs, which included from 0 to more than 4 times.

Finally, the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of FAMACHA© scores 4 or 5 and the BCS 1 or 2 to detect animals with EPG ≥ 750, were estimated with 2 × 2 contingency tables with the computational package Win Episcope 2.0 (Thrusfield et al., 2001). The latter was generated for each farm and for general data of all farms.

3. Results

3.1. Distribution and dispersion of EPG data before and after the TST

Before implementing the TST scheme, the proportion of ewes with zero EPG in different farms ranged from 32.7% to 61.0% (mean of 53.1%). The EPG distribution exhibited over-dispersion denoted by skewness values from 2.32 to 5.67 (Table 1), indicating that a large proportion of ewes had low faecal egg excretions, with median values close to 0 EPG and a small proportion of ewes excreting ≥750 EPG (from 9.2% to 25.0% of ewes). At the end of the six-month study, the proportion of ewes showing zero EPG ranged from 15.0% to 46.4% (mean 34.4%). With the exception of farm R4, the EPG excretion of the other farms exhibited over-dispersion characteristics (skewness from 2.30 to 5.12) (Table 1).

3.2. Evaluation of the TST scheme

Faecal samples were performed in 41.8% of ewes (Table 2). Most faecal samples were obtained from ewes with poor BCS 1–2 and less frequently from ewes with FAMACHA© 4–5. Only 12.1% of total events were treated with an AH (from 5.1 in R2 to 22.5% in R4). With the exception of R2, correlation analyses showed a weak positive association between FAMACHA© scores and EPG values of ewes ($P < 0.01$; Table 2). There was a weak negative association between BCS and EPG values in all farms (−0.09 to −0.23; $P < 0.05$). The total number of ewes monitored every