Scientific Paper

Evaluation of a system of selective antiparasitic treatments in Pelibuey sheep during mating and pregnancy

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Abstract

In order to evaluate a parasite control strategy based on selective antiparasitic treatments in a flock of Pelibuey sheep during the mating campaign and pregnancy, a parasite control strategy was used in 45 ewes based on selective treatments according to the color of the eye mucosa (CEM), body condition (BC) and fecal egg count (FEC). The revision of the animals was carried out between April and October, 2017, and the decision was made to treat them or not depending on the above-mentioned indicators. Low parasite rates in the animals and good productive performance of the ewes, with weights at birth of the lambs of 3,15 and 2,46 kg ($p < 0,05$) for single and double parturitions, respectively, were observed, throughout the experimental period. The FEC was the best indicator in the identification of infested animals. It is concluded that the selective antiparasitic treatment of the animals, instead of the entire flock, allowed to reduce significantly the parasite rate especially during the period close to parturition, as well as propitiated a decrease of the use of anthelmintic products.

Keywords: ewe, body condition, nematodes

Introduction

Gastrointestinal parasitism in sheep is one of the most serious threats to achieve significant productive impacts in grazing systems. The lambs as well as the ewes during lactation constitute the most susceptible categories, for which the parasite control plans should be aimed mainly at these animals.

Gastrointestinal nematodes in a population of ruminants are distributed in an aggregated way, which means that a small group of animals has most of these nematodes, while the rest shows low parasite rates (Gaba *et al.*, 2005). Thus, only a small quantity of animals in a flock would need antiparasitic treatment; nevertheless, in most cases treatment is applied to 100 % of the flock. At present, efforts are made in order to identify the animals that really need timely antiparasitc treatment, but as there are not reliable population genetic markers, in general, phenotypic traits are used, among which the following stand out: color of the eye mucosa (Marques *et al.*, 2018), the presence of diarrhea (Bentounsi *et al.*, 2012), the deterioration of body condition and fecal egg count (Gallidis *et al.*, 2009), besides the combination of these and other indicators, as proposed in The Five Point Check© (Bath and Van Wyk, 2009). The importance of these studies results in the need of reducing the development of resistance to drugs by parasites and the residues in products of animal origin.

After parturition and during lactation, ewes constitute the main source of re-infestation of the flock due to the presence of a phenomenon called periparturient rise, which is related to an increase of the egg laying rate of the parasite females as a result of a weakening of the immunity of hosts (Beasley *et al.*, 2010). For such reason, it is important to achieve an adequate parasite control strategy in these animals.

In general, under production conditions, the animals of all categories are dewormed with fixed frequencies, sometimes with intervals between 21 and 30 days. This situation, along with other factors, constitutes one of the main causes for the development of parasite resistance to the available drugs (Falzon *et al.*, 2014; Herrera-Manzanilla *et al.*, 2017).

Among the strategies of higher impact and acceptability as rational method for the parasite control in small ruminants, the selective treatments of the animals emerge. This is supported by the use of the color chart Famacha©, which is a tool based on the selective treatment of the animals depending on the color of the eye mucosa (CEM), as result of the anemia caused by *Haemonchus* spp. infestations (Pereira *et al*., 2016).

The strategy of selective treatments through the color of the eye mucosa, has been used for parasite control in sheep and goats with important results in the reduction of antiparasitic treatments and the improvement of some productive indicators (Mahieu *et al*., 2007; Papadopoulos *et al*., 2013); however, its use in moments of higher risk of parasite infestation, in different productive systems, has been little approached. That is why the objective of this study was to evaluate a parasite control strategy based on selective antiparasitic treatments in a flock of Pelibuey ewes during the mating campaign and pregnancy.

Materials and Methods

Location. The study was conducted in areas of the sheep farm of the Pastures and Forages Research Station Indio Hatuey, located at 22º 48'7'' N and 79º32'2'' W, at an altitude of 19,9 m.a.s.l.

Flock management. A flock of 45 Pelibuey ewes, with an age between three and four years, and an average weight of 45 kg, was used. A system of mountings per campaign was used, with a female-male proportion of 15:1. The campaigns started the first week of May, 2017, and lasted 45 days; April was used as reference before starting the trial.

The animals grazed in a 5,5-ha silvopastoral system divided into 10 paddocks from 9:00 a.m. to 3:00 p.m.. The pasture was constituted by a mixture of the *Dichanthium-Bothriochloa* complex (40 %) and *Megathyrsus maximus* (Jacq.) B.K. Simon & S.W.L. Jacobs (60 %), while the prevailing trees were (Lam.) de Wit, *Gliricidia sepium* (Jacq.) Kunth and *Albizia lebbeck* (L.) Benth., with higher proportion for *L. leucocephala*. The density of the trees in the system was 300-400 plants per hectare, with variable height between 2,5 and 4,0 m.

In the afternoons they received variable supplementation in collective troughs, according to feed availability, of 2 kg of chopped forage of king grass [*Cenchrus purpureus* (Schumach.) Morrone]), 2 kg of mulberry (*Morus alba* L.) foliage and concentrate feed; the last one was used strategically during the mating campaign at a rate of 150 g/animal/day. The animals rested in a roofed shed and had water and mineral salts at will.

Parasite control strategy. All the ewes were subject to an integral strategy for parasite control, based on selective antiparasitic treatments every month through the color of the eye mucosa (CEM), according to the Famacha© method (Van Wyk and Bath, 2002; Walker *et al*., 2015), in which the ewes with categories 4 and 5 were dewormed. The body condition (BC) was also used as criterion for the selective antiparasitic treatment of the animals (Soto-Barrientos *et al*., 2018). Every animal with BC lower than 2 was used as criterion for deworming. All the animals with fecal egg count (FEC) higher than 1 200 eggs per gram of feces (epg) were dewormed, as long as they had not been identified by the above-mentioned methods, their CEM were in the limit (value of 3) and their BC, with values of 2,0. Three drugs were used for treating the animals: Labiomec® (1 % Ivermectin), Levamisol® (10 % levamisole) and Labiozol® (15 % Albendazole sulfoxide), produced and commercialized by the Entrepreneurial Group Labiofam, Cuba. The doses recommended by the manufacturer were used.

The strategy also included the organization of reproduction by campaigns, utilizing the male effect (Gelez and Fabre-Nys, 2004), to concentrate parturitions in the seasons of lower risk of parasite infestation and facilitate the sanitary management of the ewes and their offspring.

Measurements. With a monthly frequency the color of the eye mucosa of each ewe was determined, through the Famacha® color chart (Van Wyk and Bath, 2002) and the body condition (Kenyon *et al*., 2014). Feces were directly extracted also from the rectum ampulla and the parasite infestation level was determined by the modified McMaster method (Arece *et al*., 2002).

The weight at birth of the lambs was determined with a digital scale of 99 kg ± 50 g (HCB 99K50, KERN & SON GmbH, Germany).

Statistical analysis. For the analysis of the differences among the FECs in the months, a mixed model of repeated measures was used through the MIXED procedure, of the statistical package SAS (SAS, 2014), in which the animal was considered as nested random effect in each sampling date and the physiological moment (mountings or pregnancy):

$$Y_{ijkl} = \mu + \tau (\rho)_{ij} + ɗ_k + \varepsilon_{ijk}$$

Where:

Y_{ijkl}: Response variable

μ: General mean

τ_i (ρ_j): Effect of the i-eth animal on the j-eth sampling date

$ď_k$: Effect of the k-eth physiological status

$εi_{jkl}$: Experimental error

The covariance structure of lower index from the Akaike and Bayesian information criteria was selected (Marques *et al.*, 2018). The differences among means were established through Duncan's test. For the CEM and BC the mode was determined, and no comparisons were established among the months.

To determine the differences among the CEM, parturition type and BC on the weight at birth of the lambs, a general linear model was used. The differences among means were determined by Duncan's test.

Results and Discussion

Table 1 shows the dynamics of the FEC, CEM and BC of the ewes in the reproduction or mating campaign (April-May) and during pregnancy (May-October). It proves that the FEC showed significant differences in the studied months (p = 0,02), with low to moderate values, which indicates that the evaluated parasite control system through selective treatments functioned satisfactorily in the identification and treatment of the infested animals under these conditions. In the case of the CEM the mode had values of 3 in all the months, and 98,2 % of the animals were classified with mucosae in good conditions (values between 1 and 3) which did not require antiparasitic treatment. On the other hand, the BC mode was between 3,0 and 3,5, with 94,0 % of the animals with score higher than 2,5.

Another aspect of great interest is that the impact of the periparturient rise phenomenon could be reduced. Under normal conditions, during the last two weeks before parturition ewes show an increase in the elimination of eggs, related to a systemic and local relaxation of the immunity of the animals (Beasley *et al*., 2010) and an increase of the egg laying rate.

As a result of selectively treating the animals, the number of treatments was lower than the expected one under normal conditions of systematic treatments (table 2), which is, in most of the cases in Cuba during the periparturient period, in fixed frequencies between 21 and 30 days (Arece-Garcia *et al*., 2016).

In this sense, the resistance of parasites to anthelmintics is closely directed to the frequent use of antiparasitics, among other factors (Chaparro *et al*., 2017), and constitutes a global problem that limits parasite control (Bartley *et al*., 2015). For such reasons, the study of strategies aimed at the decrease of the use of chemical-synthesis antiparasitics in the reduction of the selection pressure for the development and dispersal of resistance to drugs and ensure good practices in the warrant of residue-free foodstuffs, is of interest.

The combined use of these physiopathological indicators allowed to reduce the number of antiparasitic treatments. In similar studies conducted in Canada by Westers *et al*. (2017), the number of antiparasitic treatments could be reduced up to 47 %, compared with a system of conventional treatments, without significant report of deaths due to parasitism.

On the other hand, Cornelius *et al*. (2014) also recommended the treatment of the animals with lower scores of BC in the periparturient period and to maintain the remaining animals without antiparasitic treatment; thus a proportion of untreated animals could be kept, which would eliminate the eggs of non-resistant parasites. In turn, they maintain a population in refuge which contributes to delay the

Table 1. Monthly average of the fecal egg count (± SD) and mode of color of the eye mucosa and body condition.

Indicator	Month							
	April	May	June	July	August	September	October	November
FEC (epg)	35,7 (141,32)	62,5 (101,49)	966,1 (2327,38)	80,8 (216,31)	550,0 (328,24)	251,5 (639,51)	82,8 (192,38)	650,0 (1 204,63)
CEM	3	3	3	3	3	3	3	3
BC	3,5	3,5	3,0	3,0	3,0	3,0	3,0	3,0

FEC: Fecal egg count; epg: Eggs per gram of feces; CEM: Color of the eye mucosa; five categories from 1 to 5 are assigned with regards to the color of the eye mucosa, where 1 corresponds to pallid mucosae and 5 to intensely red mucosae; BC: Body condition; five categories are assigned, in which score 1 corresponds to an emaciated animal and 5 to an obese animal. The data between parentheses correspond to the standard deviation (SD±).

Table 2. Number of antiparasitic treatments per month and per category in ewes in a system of collective deworming.

Indicator	Month							Total
	April	May	June	July	September	October	November	
CEM	0	0	0	1	0	0	6	7
FEC	0	0	10	1	2	2	3	18
BC	0	0	0	0	0	1	4	5
Total	0	0	10	2	2	3	13	30

CEM: Color of the eye mucosa; five categories from 1 to 5 are assigned depending on the color of the eye mucosa, where 1 corresponds to pallid mucosae; and 5, to intense red mucosae; FEC: Fecal egg count; BC: Body condition; five categories are assigned, in which score 1 corresponds to an emaciated animal and 5 to an obese animal.

development of anthelmintic resistance (Muchiut *et al*., 2018).

An advantage of the use of BC as decision element for the treatment is that it can be simply and rapidly executed. To this it is added that no technological resources are needed and can be applied by farmers along with the Famacha© method, depending on their experience.

Table 2 shows the quantity of treatments per month and for each indicator. In the study the lack of sensitivity and specificity of the Famacha© method and of the BC to estimate high parasite rates was proven, because in June 10 animals which had not been identified by the above-mentioned variables were treated; however, they showed high parasite rates. This proves that the fecal examination is essential for the correct diagnosis of animals with high parasite infestations and should constitute routine practice in the farmers. These findings have been described in previous studies in sheep, in which it was proven that BCs with scores between 1 and 2 could not be, by themselves, sufficient to identify animals with higher rates than 750 epg (Medina-Pérez *et al*., 2015). Similar results in goats were reported by Torres-Acosta *et al*. (2014). This situation could also be appreciated as positive if it is taken into consideration that the animals in spite of having high parasite rates showed CEM and BC > 3, which is the result of possible resilience to gastrointestinal parasitism in these animals.

It was observed that only one sheep was treated twice (in April and July) by the CEM, while from the 15 animals treated in the period by FEC (> 1 200 epg), only one was treated twice in the months from June to September.

Table 3 shows the effect of the color of the eye mucosa and body condition on the weight of the lambs at birth. It is observed that both variables

Table 3. Effect of the color of the eye mucosa, body condition and type of parturition on the weight of the lambs at birth.

Indicator		n	Weight at birth	SD±	P-value
CEM	2	6	$3,05^{a}$	0,55	0,02
	3	41	$3,02^{a}$	0,47	
	4	6	$2,40^{b}$	0,69	
BC	2	1	$2,60^{b}$	-	0,01
	2,5	11	$2,75^{b}$	0,62	
	3	33	$2,97^{b}$	0,43	
	3,5	8	$3,67^{a}$	0,39	
Type of parturition	Single	37	3,15	0,39	0,04
	Double	8	2,46	0,49	

CEM: Color of the eye mucosa; BC: Body condition exert an effect on the weight at birth. As the CEM decreased, so did the weight of the lambs at birth (p < 0,05). On the other hand, the body condition also showed significant differences in the weights at birth. The animals with BC of 3,5 had the lambs with the highest weight (p < 0,05), while no significant differences were observed between the BCs from 2 to 3. The body condition score of the ewes has not shown effect on the weight of the lambs at birth in most of the studies (Sejian *et al*., 2010); however, there is a large variability in the conducted studies, which depends on several factors, such as the time in which the measurement relative to parturition was made, the number of fetuses and the nutritional status of the mother. For more details, see review made by Kenton *et al*. (2014).

It is concluded that the selective antiparasitic treatment of the animals, instead of the entire flock, allowed to reduce significantly the parasite rate especially during the period close to parturition, as well as propitiated a decrease of the use of anthelmintic products.

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