Physiopathological changes in confined Pelibuey sheep, after experimental infestation with gastrointestinal strongyles

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ABSTRACT

A study was conducted in the sheep-goat area of the EEPF "Indio Hatuey" in order to know the main physiopathological changes that occur in confined Pelibuey sheep, after infestation with gastrointestinal strongyles. Thirty animals were used, with an average age of six months and 19 kg of live weight, which were infested with 3 000 larvae of *Haemonchus* spp. (95 %), *Trichostrongylus colubriformis* (2 %) and *Oesophagostomum columbianum* (3 %). They were kept in total confinement and were supplied a balanced diet based on concentrate (CP: 16 %), chopped sugarcane and king grass forage, as well as fresh foliage from other grasses according to their requirements. The parasite infestation rate, variations of live weight, hematocrit, quantity of peripheral eosinophils and color of the ocular mucosa were determined. The prepatent period was 12 days and high infestation was found, but it could not modify the productive response of the animals –expressed in considerable weight gains–. The hematocrit decreased as a result of the infestation by *Haemonchus* spp. and the color of the ocular mucosa behaved similarly. The peripheral eosinophils increased as a result of the parasite infestation. The animals were concluded to show a response to the experimental infestation, which did not modify their productive performance; in this sense, the nutritional plane and the confinement conditions had significant influence.

Key words: Confinement, gastrointestinal strongyles, Pelibuey sheep

INTRODUCTION

Pelibuey is the most potential sheep breed for small ruminant production in Cuba and plays an important role, in small-scale economy as well as in the enterprise sector. This breed is characterized by its rusticity, prolificacy and resistance to adverse conditions (Perón, Limas and Fuentes, 2000).

In Cuba, confined sheep fattening can become a practice that allows to improve the productive indicators of this species, because of two main reasons: 1) a balanced diet based on the utilization of local resources is guaranteed, and 2) the decrease of the effects of gastrointestinal parasites (Marshall, 2000). Under the conditions of the country, gastrointestinal parasitism caused by strongyles constitutes a challenge for grazing sheep production and it is responsible for important economic losses, which sometimes causes the farmers to abandon the productive practices.

The Cuban Enterprise of Small Livestock Production encourages confined or semi-confined sheep production based on the supply of concentrates (dry distillery residues with solvents or DDGs). Under these conditions little is known about the repercussion of gastrointestinal parasitism on Pelibuey sheep. For such reason, the objective of the research was to know the physiopathological changes that occur in these confined animals, after infestations with gastrointestinal nematodes.

MATERIALS AND METHODS

Location. The study was conducted during November, 2012, to January, 2013, at the EEPF "Indio Hatuey"; it is located at 22º48'7" North latitude and 81º1' West longitude, at an altitude of 19,01 m.a.s.l.

Animals and feeding. Thirty whole Pelibuey male sheep were used, with an average weight of 19 kg and an approximate age of six months. They

were dewormed with levamisole (7,5 mg/kg of live weight) 12 days before the beginning of the trial and were maintained in total confinement.

During the experimental period, the animals received a ration based on their nutritional requirements (Shelton and Figuereido, 1990), constituted by fresh and chopped forage from sugarcane (*Saccharum officinarum*), king grass (*Pennisetum purpureum*, clon O M-22) and other grasses (*Panicum maximum*, *Dichanthium-Bothriochloa* complex), cut and carried from the forage fields of the sheep-goat area of the institution. In addition, they were supplemented with concentrate (16 % of CP) at a rate of 300 g/animal/day, and had mineral salt and good-quality water *ad libitum*. The animals were fed twice a day (at 09:00 and 14:00 hours). Adjustments were made every fifteen days in the feeding balance according to the live weight of the animals.

The sheep were confined in concrete boxers, which guaranteed adequate vital space and feeding trough front. They also had rice husk bedding, which was changed every week.

Collection of the infesting larvae (L3). An animal (donor) highly infested with a mixture of gastrointestinal strongyles (95 % *Haemonchus contortus*, 2 % *Trichostrongylus colubriformis* and 3 % *Oesophagostomum columbianum*) was used. This animal was kept in a metabolism cage to collect its feces, with which faecal culture was conducted (Roberts and O'Sullivan, 1952) for the collection of infesting larvae. The larvae were quantified, identified and preserved in refrigeration (8 ºC) until the experimental infestation date (not longer than 30 days).

Experimental procedure and measurements. After testing the efficacy of levamisole, applied to the animals 15 days before the beginning of the experiment (), they were infested (day zero) with 3 000 L_3 larvae of the above-mentioned gastrointestinal strongyles mixture. The larvae were tempered –progressively– up to 38 ºC in double boiler, to prevent sudden temperature changes and the subsequent death of the larvae. Afterwards, they were deposited at the base of the animals' tongue, by means of calibrated syringes, before supplying the feed.

Every three days the feces were extracted directly from the rectum of each animal to determine the fecal egg count (FEC), expressed in eggs per gram of feces (epg), through the modified McMaster technique (Arece, González and Cáceres, 2002). Additionally, the animals were weighed with a hook scale (100 kg ± 50 g) and the variations of live weight were determined.

Blood was extracted through the puncture of the jugular vein and was deposited in tubes with EDTA as anticoagulant, to analyze the hematocrit or packed cell volume (PCV) by means of microcentrifugation. For such purpose a capillary was filled, sealed on one of its ends and centrifuged at 12 000 rpm –during five minutes–, and thus the relative value occupied by the packed cell volume was obtained. The count of circulating eosinophils was also analyzed, using the method of Dawkins (Dawkins, Windon and Eagleson, 1989).

On the other hand, the color of the ocular mucosa (COM) was determined through the color chart for detecting anemia –FAMACHA©–, which has five categories, where 1 corresponds to an animal with intense red color, and 5, to one with pale mucosas (Van Wyk and Bath, 2002).

Data analysis. To determine the trends, the data were processed with the statistical pack SPSS® version 18.0.0 for Windows®. In addition, a linear correlation analysis was made.

RESULTS AND DISCUSSION

Figure 1 shows the dynamics of expelling of strongyle eggs through the feces of the infested animals. A prepatent period of twelve days was observed; at that time the FEC showed an increase higher than 6 000 epg, with predominance of *Haemonchus* spp. (more than 95 % of the FEC). According to Fonseca (2012), an infestation in sheep higher than 1 200 epg is considered high and causes great disorders in the animals.

Since day 22 of the experiment, the faecal count recorded a gradual decrease until maintaining an infestation lower than 2 000 epg. This could be related to development of an effective immune response to parasite infestation, which achieves the expulsion of the adult worm or the decrease of its fecundity, and is directly related to the tenancy conditions (confinement) where the possibility of reinfestation is almost null.

The productive response of the animals, expressed as an increase of the live weight (figure 2) was not affected by the infestation. This was related to the adequate nutritional plane of the supplied ration, which probably guaranteed the development of an immune response. In this sense, Torres-Acosta *et al*. (2006) found an increase of resilience to

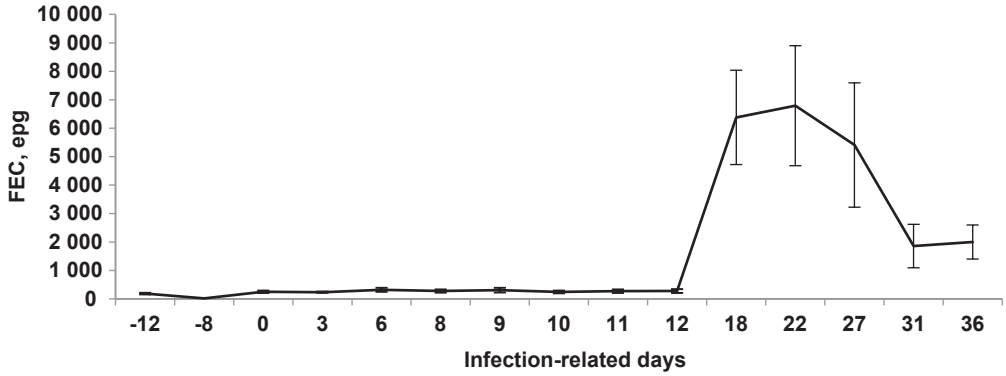

Figure 1. Variations of the fecal egg count (FEC) in sheep infested with gastrointestinal strongyles.

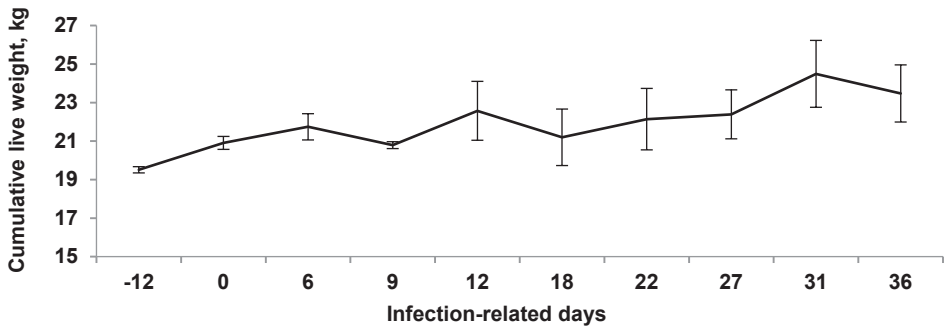

Figure 2. Average live weight of sheep artificially infested with gastrointestinal strongyles.

parasite infestation in growing kids, when balanced feeding was guaranteed. On the other hand, the characteristic rusticity of the Pelibuey sheep could have influenced, along with a possible natural resistance to gastrointestinal parasitism of this breed like the one found by González *et al*. (2008); as well as the conditions created in the confinement, where the animals do not have large energy losses –like the ones that occur during grazing– and it leads to an increase in feed utilization.

Figure 3 shows that at the beginning of the infestation the animals had a hematocrit average close to 29 %. Since the increase of the FEC was recorded (twelfth day of post-infestation) this indicator started to decrease to values below 21 %, which is related to the presence of *Haemonchus*. It is documented that the hematocrit is modified as a consequence of the infestations by this parasite (Abbott, Parkins and Holmes, 1988), which is highly hematophagous and can suck up to 0,03 mL of blood per day (Urquhart, 1996). The relation between the hematocrit and the FEC was inverse ($r = -0,33$, $p < 0,05$) and lower than the one found in grazing Pelibuey sheep (-0,44) (Arece and López, unpublished).

The COM allows to evaluate the degree of anemia of the animals (Vatta *et al*., 2001; Arece, Rodríguez-Diego and López, 2007). Several studies have proven the existence of a relation among the COM, the magnitude of the anemia and the presence of *Haemonchus* spp. (Bath, Malan and Van Wyk, 1996; Kaplan *et al*., 2004). This indicator (fig. 4) showed values between 2 and 3 of the FAMACHA© color chart, which correspond to animals which do not show evident deterioration of their general state. On day 18 the mucosas were found to be paler, due to the increase of the FEC recorded on that date (fig. 1), with a predominance of *Haemonchus* spp. Since that moment it was recovered to level 2; however, the standard errors showed higher variability as a result of the individuality of the animal response to the parasite infestation.

As stated above, the productive results could be consequence of an immunological response by

the animals. This was partly corroborated by a remarkable increase of the peripheral eosinophils (fig. 5); they constitute effective defense cells against parasite infestations, especially those caused by *Haemonchus contortus* (Meeusen and Balic, 2000; Valderrábano, Delfa and Uriarte, 2002; Marie Magdeleine *et al*., 2010; Pathak and Tiwari, 2013). Peripheral eosinophils have been used as criterion for the selection of animals resistant to parasitism, due to their close link to the parasite phenomenon (Douch, 1996).

It is concluded that the animals showed a response to the experimental infestation, which did not modify their productive performance or the main homeostatic physiological variables. Thus, it is proven that with an adequate nutritional plane an increase of the sheep resilience to parasite infestations is achieved.

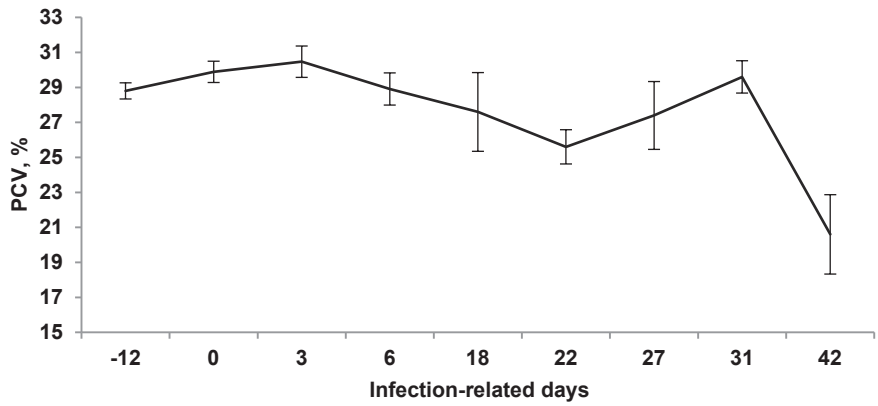

Figure 3. Average hematocrit (PCV) in sheep artificially infested with gastrointestinal strongyles.

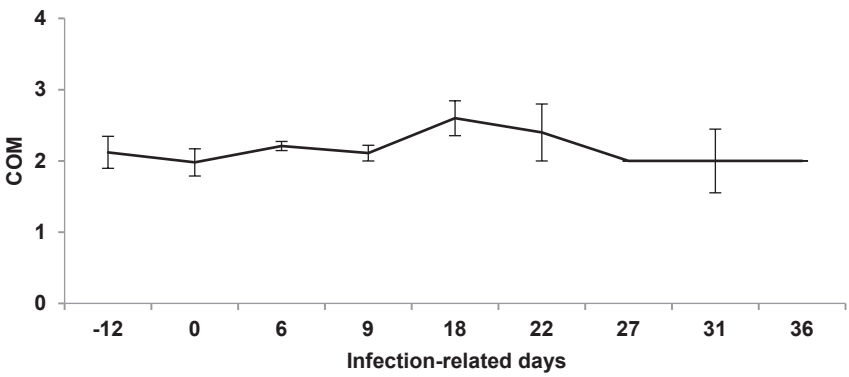

Figure 4. Color of the ocular mucosa in sheep artificially infested with gastrointestinal strongyles.

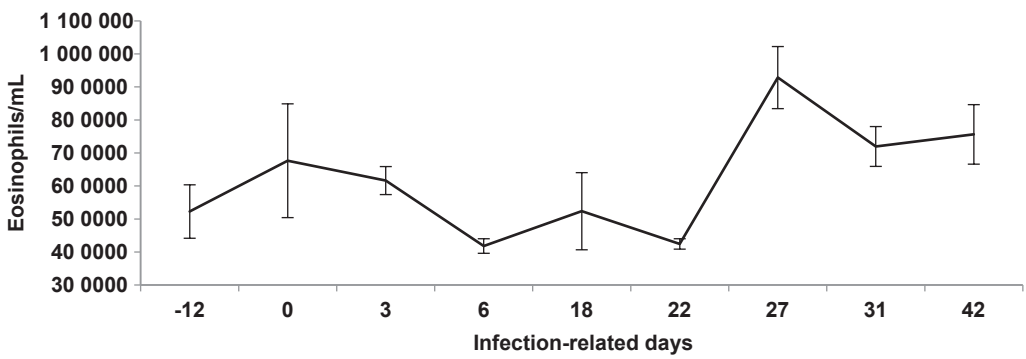

Figure 5. Count of eosinophils in sheep artificially infested with gastrointestinal strongyles.

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