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Article

Epizootiological factors of gastrointestinal strongyloses in Cuban Creole goats: bases for integrated management

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Abstract:

Parasitism caused by strongyles is one of the main limiting factors of the production of Creole goats in eastern Cuba. Through a descriptive and exploratory research carried out during the period between 2013 and 2018, the factors that regulate the epizootiological dynamics of gastrointestinal strongyloses were identified in 18 herds. The factors under control were: the population dynamics of larvae per month, the reproductive states and the growth process of the goats. The monthly dynamics of infective larvae in the pasture were recorded. Simple ANOVAS for linear models corresponding to each factor and the Newmankeuls test for multiple comparisons of means were applied. It was observed that the parasitic dynamics of gastrointestinal strongyloses, which affect Cuban Creole goats, are related to physiological and zootechnical processes. In these dynamics, two critical moments or peaks of infestation were identified: in growing animals during the weaning period (2,188 eggs per gram, EPG) and in breeding females in peripartum periods (972 EPG). The general infestation of the herds is conditioned by the combination of greater ingestion of infective larvae, processes of food stress and predisposing physiological states, which lead to seasonal infestation peaks between the months from December to February greater than 1,500 EPG. The dynamics of pasture infestation are related to rainy seasonality with infestation peaks between the months from July to September and an average maximum of 1,200 larvae per kilo of grass.
Key words: Goats, Parasitic infestation, Host, Pasture.

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Introduction

Cuban Creole goats are a genotype differentiated from their Iberian and African ancestors[1]. This differentiation is the result of 500 yr of coevolution in the socio-environmental context of eastern Cuba, a region where more than 90 % of the Cuban goat population is concentrated and where the first group of animals of this breed was officially registered[2].According to La O *et al*[3], these animals are typical of peasant breeding systems, mainly with self-subsistence objectives. For this reason, their breeders allocate very few inputs for this activity, and expect to have their productions based on the rusticity of the genotype. However, other researchers found that these animals could carry significant loads of gastrointestinal strongyles and even reported the presence of two species of *Haemonchus, contortus* and *placei,* the latter, of high specificity for cattle[4].

Several studies on the effect of this parasitic group have shown that they can affect more than 25 % of the productive potential of animals, without showing signals to producers(5). In this way, it is estimated that parasitism caused by strongyles is one of the main limiting factors of the production of Creole goats in eastern Cuba.

This situation generates controversy about the most convenient strategies for the development of traditional breeding systems. Conventional schemes of anthelmintic treatments are not compatible with the traditional rationality of breeding, for this reason everything points to develop integrated control strategies more consistent with the vision of the peasant breeder.

To generate integrated control strategies, it is important to identify the particularities of the parasitic process for these goats in the region. From this problem, the research question that gave rise to the present study is generated, what are the factors that define the dynamics of gastrointestinal strongyloses that affect Cuban Creole goats? Then, the objective was to identify the factors that regulate the dynamics of gastrointestinal strongyloses of Cuban Creole goats.

Material and methods

Study location and sample

The research was carried out in the sub-basin of the Cautillo-Jiguaní rivers, of the Cauto River Valley, located in eastern Cuba, Municipality of Jiguaní, province of Granma (Figure 1) The herds belonged to the community “26 de Julio”, an area where specimens of this breed were registered for the first time in Cuba as pure racial.

Figure 1: Location of the study area

Eighteen (18) herds were selected in correspondence with the traditional breeding typologies for this breed, identified by La O *et al*(3). In total, 860 animals were studied, of them: 26 bucks, 455 breeding females and 379 growing animals. The animals were evaluated by experts and classified as Cuban Creoles.

Research design

The research carried out was descriptive and exploratory. The object of study was the parasitic process by means of two variables or indicators: 1) the number of parasite eggs per gram of feces (EPG) and the number of infective larvae in the grass (larvae per kilo of grass). These variables were monitored for three years, with a monthly frequency.

In the case of hosts, a minimum sample of 10 animals per herd was taken, but which as a whole represented more than 10 % of the existing animals by category. A total of 3,715 samples of feces were worked on. In the case of pastures, samples were taken from the area under occupation and from areas with less than 28 d of rest. In total, 1,250 samples of pastures from the 18 breeding units were worked on.

The epizootiological influence factors contolled were: a) month of the year; b) breeding category (bucks, breeding females and growing animals until weaning (120 d) and after weaning); c) physiological state (dry and empty animals, gestation time and lactation time).

Parasitological studies

Samples of feces were taken before 0800 h, with a monthly frequency. To identify the genera present, cultures were carried out for 7 d protected with activated carbon. Egg counting was performed using the Mac Master technique(6). In the case of pastures, the sample was taken before 0800 h, through a tour of the grazing areas in which small portions of grass were collected every 10 steps. For the counting of infective larvae per kilo of grass, the technique described by Arece and Rodríguez(7) was used.

Statistical analysis

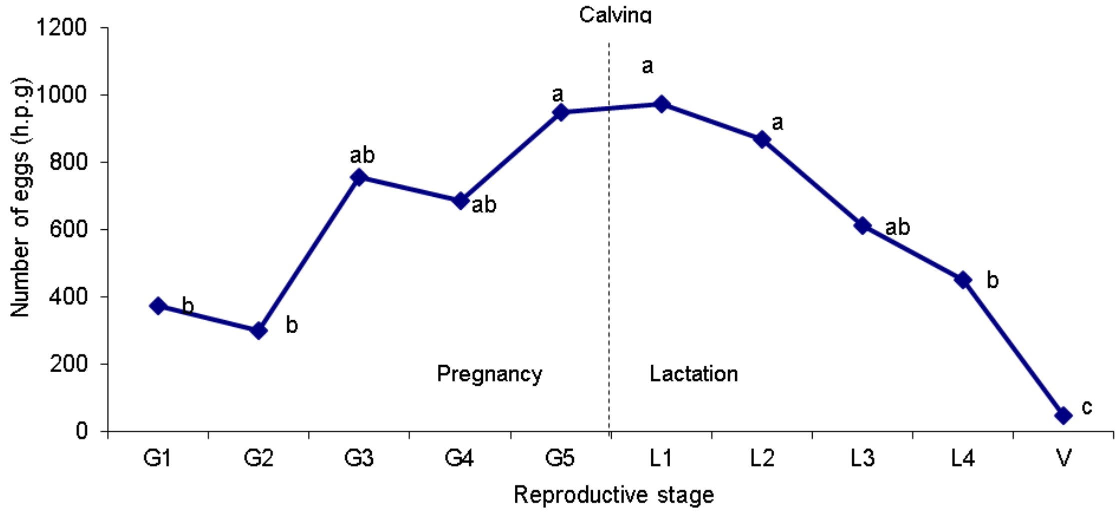
Simple ANOVAS were applied for linear models corresponding to each of the controlled factors (growth period, month, reproductive states). For multiple comparisons of means, the Newmankeuls test was applied. The software used was STATISTICA 12.0(8).

Results and discussion

The genera of parasites diagnosed in cultures of larvae were *Haemonchus* (48 %), *Bunostomun* (23 %), *Trichostrongylus* (23 %) and *Oesofagostomun* (6 %). This population structure was consistent with the results reported by Rojas *et al*(4) in this same locality. In fact, it is consistent with a population structure pattern characteristic of tropical areas(9). The predominance of the genus *Haemonchus* is given by the favorable conditions to develop its exogenous phase throughout the year and because it is a much more prolific group than the rest of the identified genera(10). The genera *Haemonchus* and *Oesophagostomum* predominate at high temperature and humidity, while the genus *Cooperia* does so in humid and tropical climates in reverse of *Teladorsagia* that occurs in temperate or cold climates(11).

For the dynamics of egg expulsion during the reproductive cycle (Figure 2), an increase was found during the peripartum period; epizootiological phenomenon called PPR, described by several authors(12-13); those who report that, during this period, which includes one month before and one month after calving, certain immunosuppressive processes occur that promote the development of larvae that had remained hypobiotic.

Figure 2: Dynamics of egg expulsion in goats during the reproductive cycle



G1 to G5= pregnant form 1 to 5 mo; L1 to L4=lactationg from 1 to 4 mo; V= open.
ab *P*<0.01; CV= 12 %.

The possibility of increases in the fertility of female parasites with higher egg productions is not ruled out either. Figure 3 shows two photos of females of *Haemonchus* spp., in the section near the vulvar flap. In these images, a greater apparent load of eggs in the female of parasites, recovered from a breeding female in peripartum, can be observed. This is not conclusive evidence, but it induces research to test this hypothesis.

Figure 3: Sections of vulvar flaps of females of *Haemonchus* spp., recovered from breeding female goats within and outside of the peripartum period (Photos: Manuel A. La O Arias).

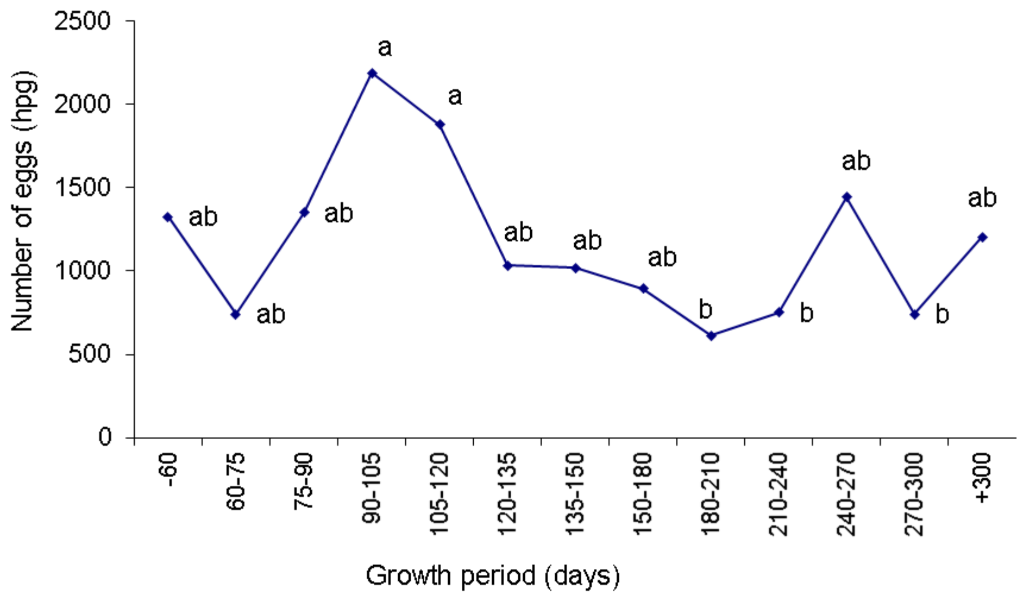
Hembra de *Haemonchus* spp., recuperada de una reproductora caprina no gestante Aleta vulvar lingüiforme.

Hembra de *Haemonchus* spp., recuperada de una reproductora caprina con 120 días de gestación. Aleta vulvar botonosa.

In Cuba, the first report of processes of increased parasitic activity in the peripartum period was carried out in the sheep species(14). In this research, the first report of the peripartum process in the goat species in Cuba is made.

Regarding the dynamics of egg expulsion during the growth period (Figure 4), it was found that the infestation of the kids begins to manifest itself shortly before 60 d and shows a trend to increase until reaching significant peaks (P<0.001) between 90 and 120 d (more than 1,800 eggs per gram (EPG). This period coincides with the fall in milk consumption, either due to weaning or a significant reduction in the mother's production. From that moment (120 to 135 d), the infestation reduces significantly until reaching the lowest levels at 180 d of age with sporadic peaks.

Figure 4: Dynamics of parasite egg expulsion in growing Creole kids

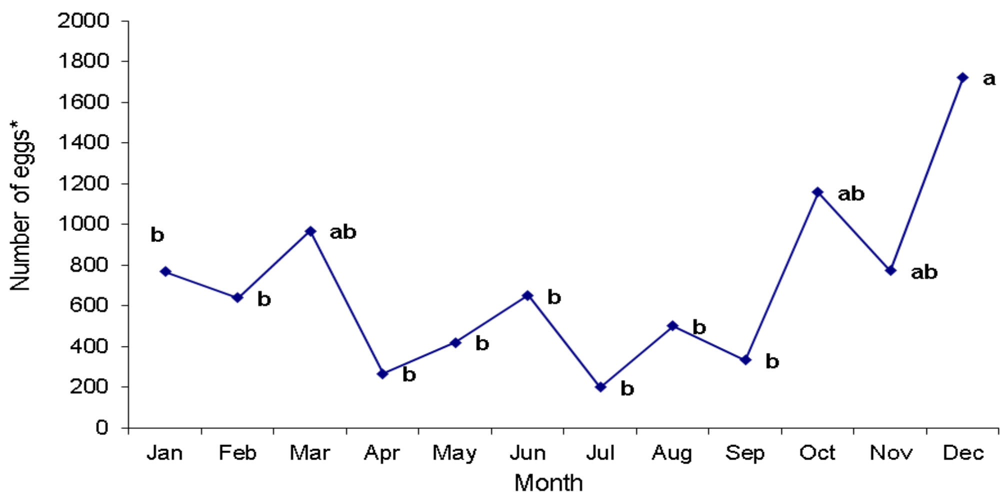


ab P<0.10; CV= 20 %.

The increase in infestation in the kids around weaning has been reported by different authors(15-16), who agree that the kids have an immature immune system to which weaning stress is added. When milk consumption reduces or is truncated abruptly, the consumption of grass increases, therefore, the consumption of infective larvae increases. In this period, the active immunity response mechanisms in growing animals begin to be activated(17). As for the reduction of the count from 180 d, the process called "self-cure" occurs in sheep, which is verified around this same period (180 d). This process has immunological bases, and its continuity will be determined by factors that alter the state of general resistance of the host individual(18).

The monthly dynamics of the expulsion of eggs in the feces (EPG) in the breeding females (Figure 5) showed that the level of infestation tended to increase from October. The peak of infestation occurred in December (1,722 EPG), which denotes a higher level of infestation during the dry months.

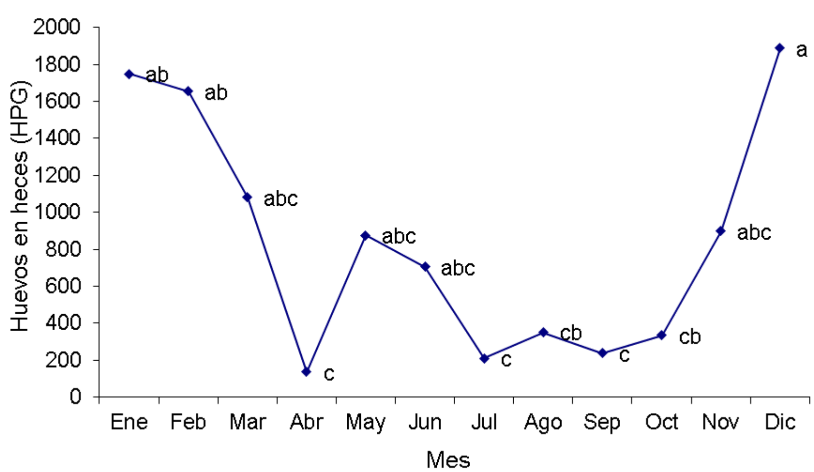
Figure 5: Monthly dynamics of the count of parasite eggs in feces in Creole breeding female goats



*Transformed means; ab $P<0.01$; CV= 15 %.

The monthly dynamics of the count of eggs in growing animals (Figure 6) showed the highest levels in December, January and February ($P<0.001$), which coincides with the dry period and the lowest temperatures. In March and April, the infestation begins to decrease, with a new milder peak in May (beginning of the rainy period). Subsequently, the infestation descends until reaching the lowest levels between July and October. From November (beginning of the dry period), it begins to increase again.

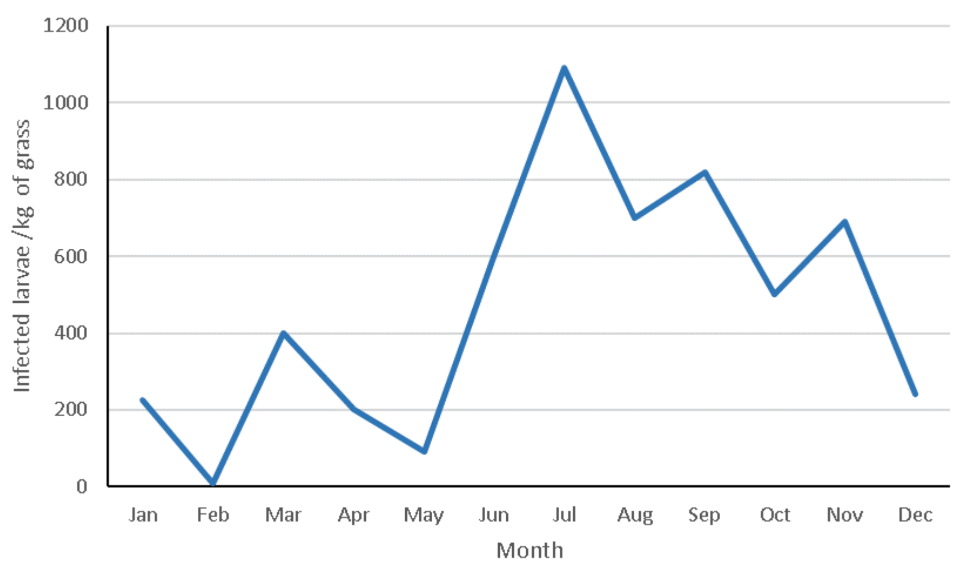
Figure 6: Monthly dynamics of egg count in growing Cuban Creole goats



Bedotti *et al*[11] explained that, in the dry period, the conditions are less conducive to the development of the exogenous phase of the biological cycle of these parasites, due to the combination of high temperatures and low humidity, lethal for pre-infective larvae. Several studies conducted in tropical conditions on minor species show higher infestations during rain[19]. This behavior, in the traditional breeding systems of Creole goats, in Cuba, is reinforced by the absence of food supplementation practices in the dry period. Stocking rates in pasture areas increase depending on food availability[1]. Then, there is a drop in the state of resistance of the hosts due to food stress and gastrointestinal strongyloses begin to appear with more intensity. In this case, the parasites find more susceptible hosts that provide them with better conditions for the development of the endogenous phase of their biological cycle. In addition to food stress, the thorough consumption of pastures and favorable levels of humidity create favorable conditions for the herd to consume more infective larvae. Humidity favors the processes of development and migration of parasitic larvae.

Figure 7 shows the monthly dynamics of the population of infective larvae in the pasture. The highest infestation levels occurred in the period from July to November. These periods of maximum larval contamination coincide with the rainy season, where climatic conditions favor the development of larvae.

Figure 7: Behavior of the monthly dynamics of infective larvae in the pasture in breeding systems of Cuban Creole goats



During the exogenous phase, the conditions of humidity, temperatures and radiation define the success of the development of the larvae. Therefore, seasonal variations in these environmental parameters are generally a determining factor in the epidemiological behavior of gastrointestinal strongyloses. According to Bedotti *et al*[11], high temperatures in the summer period cause mortality of infective larvae, which reduces the population of nematodes. High temperatures, above 35 to 40 °C occur as the second factor of importance with a lethal action on the pre-infesting instars.

In the study area, annual maximum temperatures range between 29 and 33 °C, while average minimums range between 17 and 22 °C[20]. This temperature range is optimal for larval development in pasture throughout the year. So, the seasonality described in this study is determined by various interactions between the seasonality of rainfall and the physiological states of the hosts.

In the Cauto Valley, there are two well-defined climatic periods: 1) the rainy period, from May to October and 2) the dry period, from November to April. Ramírez *et al*[20] described the variations in biomass production associated with these periods, which explains the larval dynamics of the pasture. However, the dynamics of infestation in the host follow the combination of more complex processes. In breeding females, the effect of food stress, in dry period, is combined with the physiological stress of peripartum. This combination is reflected in the peak of infestation identified in December, where births are concentrated[1] and food stress is exacerbated by the low biomass production that characterizes that month. In the case of growing animals, this peak due to food stress in the dry period is also verified, but, in addition, a less marked peak is observed in May. This behavior in epizootiology of gastrointestinal parasitism is known as “spring rise”.

The “spring rise” had already been reported in mountain conditions in eastern Cuba[21]. Although it is necessary to continue studying this aspect of the monthly dynamics, it can be said that, in both cases, there are three points of coincidence that help explain the causes of this peak. First, in this period weaning is concentrated, which means many stressed animals. Second, grazing areas are highly contaminated by the concentration of females in the peripartum period that deposit feces with high EPG values. Third, the beginning of the rains facilitates the dilution of the feces and the migratory processes of the infective larvae accumulated in the last month of the dry period.

Conclusions and implications

The parasitic dynamics of gastrointestinal strongyloses, which affect Cuban Creole goats, are related to physiological and zootechnical processes that define critical moments in growing animals during the weaning period (2,188 EPG) and for breeding females in peripartum periods (972 EPG). The general infestation of the herds is conditioned by the combination of greater ingestion of infective larvae, food stress processes and predisposing physiological states, which condition infestation peaks greater than 1,500 EPG between the months from December to February. The dynamics of pasture infestation are related to rainy seasonality with infestation peaks between the months from July to September with an average maximum of 1,200 larvae per kilo of grass.

Conflicts of interest

The authors declare that they have not received any funds for the conduct of this research. There is also no conflict of interest between the authors and the journal, or any other instance or institution related to this research. This work, due to the type of research carried out, does not have any ethical or bioethical implications.

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