ANTHELMINTIC RESISTANCE IN SMALL RUMINANTS FROM THE SEMIARID OF PARAÍBA STATE, BRAZIL

RESISTÊNCIA ANTI-HELMÍNTICA EM PEQUENOS RUMINANTES DO SEMIÁRIDO DA PARAÍBA, BRASIL

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SUMMARY

This study aimed to evaluate the effect of Ivermectine 0.08% and Levamisole Hydrochloride 5% in controlling sheep and goat gastrointestinal helminthiasis from Agreste region of Paraíba State, Northeastern Brazil. The experiment was conducted from July 2011 to February 2012 with animals of both sexes from 28 farms, aged from three to 48 months. Eighteen animals without any anthelmintic treatment for at least three months were chosen from each farm. The animals were divided into three groups: group 1, treated with Ivermectine 0.08%, orally, in a single dose of 2.5 mL/ 10 kg l. w.; group 2, treated with Levamisole Hydrochloride 5%, orally, in a single dose 1.0 mL/ 10 kg l. w. and group 3, which received no anthelmintic treatment, serving as a control group. Fecal samples were collected on zero and ten days after treatments for fecal analysis. The treatment with Levamisole Hydrochloride reduced the parasite load of goats and sheep by 86.7% and 93%, respectively, while the treatment with Ivermectine, reduced the load only by 30.9% in goats and 24.6% in sheep. The most prevalent helminth species was *Haemonchus* spp. The gastrointestinal nematodes of goats and sheep from Agreste of Paraíba State are highly resistant to Ivermectine. Levamisole Hydrochloride is still effective in sheep, but already shows resistance traces in goats.

KEY-WORDS: Goats. Helminthes. Ivermectine. Levamisole. Semiarid. Sheep.

RESUMO

Este estudo objetivou avaliar o efeito da Ivermectina 0,08% e do Cloridrato de Levamisole 5% no controle das helmintoses gastrintestinais de ovinos e caprinos da mesorregião do Agreste do Estado da Paraíba, Nordeste do Brasil. O experimento foi desenvolvido no período de julho de 2011 a fevereiro de 2012. Foram utilizadas 28 propriedades, com animais de ambos os sexos e idades entre três e 48 meses. Em cada propriedade foram escolhidos 18 animais sem tratamento anti-helmíntico a pelo menos três meses. Os animais foram divididos em três grupos: grupo 1, tratado com Ivermectina 0,08%, via oral, em dose única de 2,5 mL/ 10 kg p. v.; grupo 2, tratado com Cloridrato de Levamisole 5%, via oral, em dose única de 1,0 mL / 10 kg p. v. e grupo 3, que não recebeu tratamento anti-helmíntico, servindo como grupo controle. Amostras fecais foram coletadas nos dias zero e dez dias após os tratamentos para realização das análises fecais. O tratamento com Cloridrato de Levamisole reduziu 86,7% e 93% a carga parasitária de caprinos e ovinos, respectivamente. Entretanto, o tratamento com Ivermectina reduziu apenas 30,9% em caprinos e 24,6% em ovinos, O helminto mais prevalente nas coproculturas foi o *Haemonchus spp.* Os nematódeos gastrintestinais de caprinos e ovinos do Agreste da Paraíba encontram-se altamente resistentes à Ivermectina. O Cloridrato de Levamisole ainda é efetivo em ovinos, mas já apresenta traços de resistência em caprinos.

PALAVRAS-CHAVE: Caprinos. Helmintos. Ivermectina. Levamisole. Ovinos. Semiárido.

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INTRODUCTION

Goat and sheep production occupies a prominent place in the Brazilian Northeast, where farmers use their products both for own consumption and commerce, resulting in stability and development. In the Agreste region of Paraíba State, the small ruminant production is a viable activity and a major source of animal protein for human consumption. However, there are some limiting factors in the productivity of the herds, including the gastrointestinal helminthiasis, responsible for decreased food intake, nutrient absorption, and meat and milk production, as well as growth retardation and increased mortality (LIMA et al. 2010a).

The main form of parasite control is done by chemicals with broad spectrum activity, most often administered empirically (CEZAR et al. 2010). Among the most widely used anthelmintics, Ivermectine stands out. It belongs to the group of macrocyclic lactones, which act by opening chloride channels targeted by glutamate causing parasite neuromuscular paralysis. Another compound widely used is the Levamisole Hydrochloride which belongs to the imidazothiazoles group. They act on acetylcholine receptors, causing muscle contractions and worm paralysis (COLES et al. 2006).

The irrational use of anthelmintics has contributed to the increased resistance of the small ruminant gastrointestinal helminthes to the most readily available drugs. Several studies report the resistance of these helminthes to Ivermectine and Levamisole Hydrochloride in Brazil (CEZAR et al. 2010; MORAES et al. 2010; LIMA et al. 2010b). However, no studies of anthelmintic resistance in the Agreste region of Paraíba State have been conducted.

Due to lack of studies evaluating the efficacy of anthelmintics in this region, this study aimed to evaluate the effect of Ivermectine 0.08% and Levamisole Hydrochloride 5% on the gastrointestinal helminthiasis control of sheep and goats.

MATERIAL AND METHODS

The experiment was conducted in small ruminant production farms in the Gado Bravo county, Agreste of Paraíba State, from July 2011 to February 2012. The region has a semi-arid climate, with a rainy season from April to July, when 90% of rainfall occurs, and a dry season. The annual temperature average is 23.5°C (minimum 18°C and maximum 29°C), with little variation over the year (VILELA et al. 2008). This region includes the transition zone between the moist coast and the semiarid backwoods, presenting vegetation of the Caatinga biome.

We used 15 goat and 13 sheep herds (270 and 234 animals, respectively), totaling 28 herds and 504 animals of both sexes, between three to 48 months-old, without defined breed. Eighteen animals from each herd, that were not subjected to anthelmintic treatment for at least three months prior to the experiment and presenting OPG≥500 were chosen. Subsequently, animals were individually identified and randomly assigned into three groups: group 1, treated with Ivermectine 0.08%, orally, in a single dose of 2.5 mL/ 10 kg l. w.; group 2, treated with Levamisole Hydrochloride 5%, orally, in a single dose of 1.0 mL/ 10 kg b. w. and group 3, received no anthelmintic treatment, serving as a control group.

Fecal samples were individually collected on zero and ten days after treatment and sent to the Laboratory of Parasitic Diseases of Domestic Animals of the Universidade Federal de Campina Grande (UFCG), Patos - PB, for fecal examination. Counting of Eggs Per Gram of feces (EPG), according to Whitlock & Gordon (1939) and larval culture, according to Roberts & O'Sullivan (1950) were performed.

The Fecal Egg Count Reduction test (FECR) was performed according to Coles et al. (1992). Subsequently, the data were subjected to one-way variance analysis, and followed by Tukey test at 5% probability. The EPG values were analyzed using logarithmic transformation log (x + 1), however, they are presented as arithmetic averages of untransformed values. The analyses were performed using the BioEstat 5.0 Software. The efficacy classification of the drugs was based on Technical Regulation Ordinance N°. 48/1997 of the Ministério da Agricultura, Pecuária e Abastecimento (MAPA) for chemicals endowed with antiparasitic activity using the following criteria: a drug is characterized highly effective when it reduces parasites more than 98%; effective for 90-98%, moderately effective for 80-89%, and insufficiently active for <80% reduction (BRASIL, 1997).

This research was submitted to the Research Ethics Committee of UFCG and obtained the protocol number 017/2012.

RESULTS

A statistically significant difference ($p<0.05$) was observed between goat and sheep anthelmintic treatments (Table 1).

The Ivermectine 0.08% EPG did not reduced parasites satisfactorily, especially in sheep, where the result was not statistically different ($p>0.05$) from the control group. Levamisole Hydrochloride 5% was the best treatment, differing significantly ($p<0.05$) from the other groups in EPG values post-treatment in both species.

According to Brasil (1997), Ivermectine was insufficiently active in goats (30.9%) and sheep (24.6%). Levamisole Hydrochloride already appeared moderately effective in goats (86.7%) and effective in sheep (93%).

The percentages of helminths recovered from fecal cultures are shown in Table 2.

Table 1 - Values of EPG and FECR of goat and sheep submitted to anthelmintic treatments in the Agreste region of Paraíba State, Brazil.

Groups	Goats			Sheep		
	0	10	FECR	0	10	FECR
Ivermectine 0.08%	5376 ^{Aa}	4081 ^{Ab}	30.9%	1800^{Aa}	1255^{Ba}	24.6%
Levamisole Hyd. 5%	5516 ^{Aa}	783 ^{Bc}	86.7%	1521^{Aa}	116^{Bb}	93.0%
Control	5798 ^{Aa}	5914 ^{Aa}	-	1682^{Aa}	1665^{Aa}	-

Values followed by the same letters capital in lines and lower case in columns did not statistically differ (p>0.05) – Tukey test.

Table 2 - Percentages of gastrointestinal helminths recovered from fecal cultures of goat and sheep submitted to anthelmintic treatments in the Agreste region of Paraíba State, Brazil.

		Control		Ivermectine 0.08%		Levamisole Hyd. 5%	
		0	10	0	10	0	10
Goats	H	70	68	78	56	38	42
	T	25	31	20	34	60	51
	S	0	1	2	4	0	2
	O	5	0	0	6	2	5
Sheep	H	40	49	35	53	45	63
	T	55	38	58	34	40	37
	S	2	11	3	10	11	0
	O	3	2	4	3	4	0

H: *Haemonchus* spp.; T: *Trichostrongylus* spp.; S: *Strongyloides* spp.*;* O: *Oesophagostomum* spp.

The most prevalent helminth gender in fecal cultures was *Haemonchus* spp., followed by *Trichostrongylus* spp., *Strongyloides* spp., and *Oesophagostomum* spp.

DISCUSSION

It was observed that Ivermectine 0.08% did not satisfactorily reduce the animals worm load, with reduction rates of only 30.9% in goats and 24.6% in sheep. High anthelmintic resistance was also observed by Lima et al. (2010a), when evaluating the efficacy of Ivermectine 0.02% in goat herds from Cariri region of Paraíba State, obtaining reduction of 50.1%. Pereira et al. (2008) evaluating this anthelmintic in goats and sheep from Rio Grande do Norte State, Brazil, reported a reduction of only 14.2% and 20.7%, respectively. However, George et al. (2011) evaluated Ivermectine in sheep from Trinidad and Tobago getting 95-97% of FECR, classifying it effective. Lima et al. (2010b) in Pernambuco State, Brazil, observed that Ivermectine showed an efficacy of 67.33% in goats, indicating resistance, although in sheep it presented 100% efficacy, which characterized it highly effective.

Several studies around the world have confirmed the resistance of gastrointestinal helminthes of small ruminants to Ivermectine (LIFSCHITZ et al. 2010; LIMA et al. 2010a; LEATHWICK et al. 2012).

Levamisole Hydrochloride 5% showed reductions of 86.7% and 93% for sheep and goats, respectively, similar to that observed by Rodrigues et

al. (2007), when tested this anthelmintic in goats from the Sertão region of Paraíba, with 93.3% of efficiency. Duarte et al. (2012), testing this anthelmintic in Northern Minas Gerais State, Southeastern Brazil, achieved efficacy ranging from 90% to 100%. However, Leathwick et al. (2012) observed resistance to this anthelmintic (efficacy<70%) in New Zealand sheep and George et al. (2011) observed efficacies from 53% to 81% in sheep from Trinidad and Tobago.

The resistance rates to Levamisole Hydrochloride 5% observed in some farms may be due to its low efficacy against immature stages of nematodes in general (MELO et al. 2003).

The most prevalent helminth species was *Haemonchus* spp., corroborating with Vilela et al. (2012). Probably, this worm acquires faster resistance due to its high biotic potential and genetic variability, as well as hosting the allele that causes decreased susceptibility to a drug (BLACKHALL et al. 1998). *Haemonchus* spp., *Trichostrongylus* spp., *Strongyloides* spp. and, to a lesser extent, *Oesophagostomum* spp. were detected. Similar percentages of these helminths were also observed in other studies conducted in Northeastern Brazil (LIMA et al. 2010a; COSTA et al. 2011).

Several factors contribute to the development of anthelmintic resistance and consequent inefficiency of antiparasitic drugs. The indiscriminate use of these drugs is one of them, which is mostly due to the producers' lack of knowledge, poor management practices and the ease of acquiring these drugs. According to Vilela et al. (2012), high resistance to anthelmintics observed in studies conducted in semi-arid regions of Northeastern Brazil may be due to the fact that deworming of all small ruminant herds four to six times per year is a common practice.

The idea that anthelmintic control based only on massive herd deworming is a wrong practice must be disseminated. To minimize the effects of gastrointestinal helminthiasis an integrated control strategy is needed. A combination of synthetic anthelmintics with alternative forms of control such as the use of anthelmintic plants, the Famacha© method and/ or in the near future, nematophagous fungi, associated with good practices of herd management may provide the solution.

CONCLUSION

Goats and sheep gastrointestinal nematodes of the Agreste region of Paraíba State are highly resistant to Ivermectine 0.08%. Some resistance to Levamisole Hydrochloride 5% was observed in goats.

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