

31 de julho de 2011 a fevereiro de 2012. Foram utilizadas 8 propriedades, com animais de ambos
32 os sexos e idades entre três e 48 meses. Em cada propriedade foram escolhidos 18 animais
33 sem tratamento anti-helmíntico a pelo menos três meses. Os animais foram divididos em três
34 grupos: grupo 1, tratado com Ivermectina 0,08%, via oral, em dose única de 2,5 mL/ 10 kg p.
35 v.; grupo 2, tratado com Cloridrato de Levamisole 5%, via oral, em dose única de 1,0 mL / 10
36 kg p. v. e grupo 3, que não recebeu tratamento anti-helmíntico, servindo como grupo controle.
37 Amostras fecais foram coletadas nos dias zero e dez dias após os tratamentos para realização
38 das análises fecais. O tratamento com Cloridrato de Levamisole reduziu 86,7% e 93% a carga
39 parasitária de caprinos e ovinos, respectivamente. Entretanto, o tratamento com Ivermectina
40 reduziu apenas 30,9% em caprinos e 24,6% em ovinos, O helminto mais prevalente nas
41 coproculturas foi o *Haemonchus* sp. Os nematódeos gastrintestinais de caprinos e ovinos do
42 Agreste da Paraíba encontram-se altamente resistentes à Ivermectina. O Cloridrato de
43 Levamisole ainda é efetivo em ovinos, mas já apresenta traços de resistência em caprinos.

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45 **PALAVRAS-CHAVE:** Caprinos. ivermectina. ovinos. semiárido.

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47 INTRODUCTION

48 The goat and sheep production occupies a prominent place in the Brazilian Northeastern,
49 where farmers use their products in food and commerce, resulting in stability and
50 development. In the Agreste region of Paraíba State, the small ruminant production is a viable
51 activity, generating a major source of animal protein for human consumption. However, there
52 are some limiting factors in the productivity of the herds, including the gastrointestinal
53 helminthiasis, responsible for the decrease in food intake and nutrient absorption, growth
54 retardation, decrease in the meat and milk production and mortality (LIMA et al. 2010a).

55 The main form of parasite control is done by the use of chemicals with broad spectrum
56 of activity, most often administered empirically (CEZAR et al. 2010). Among the most
57 widely used anthelmintics, the Ivermectine stands out, belonging to the macrocyclic lactones
58 group, which act by opening chloride channels targeted by glutamate causing parasite

59 neuromuscular paralysis. Another compound widely used is the Hydrochloride of Levamisole,
60 belonging to the imidazothiazoles group, which has action on acetylcholine receptors, causing
61 muscle contractions and worm paralysis (COLES et al. 2006).

62 The irrational use of anthelmintics has contributed to the resistance to the most available
63 drugs of the small ruminant gastrointestinal helminthes. Several studies reports the resistance
64 of these helminthes to Ivermectine and Hydrochloride of Levamisole in Brazil (CEZAR et al.
65 2010; MORAES et al. 2010; LIMA et al. 2010b), however no studies of anthelmintic
66 resistance in the Agreste region of Paraíba State were conducted.

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

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71 **MATERIAL AND METHODS**

72 The experiment was conducted on farms of small ruminant production system in the
73 Gado Bravo city, Agreste of Paraíba State, during July 2011 to February 2012. The region has
74 a semi-arid climate, with a rainy season from April to July, which 90% of rainfall occurs and
75 a dry season. The annual temperature average is 23,5°C (minimum of 18°C and maximum
76 29°C), with little variation over the year (VILELA et al. 2008). This region includes the
77 transition zone between the moist coast and the semiarid backwoods, presenting vegetation of
78 the Caatinga biome.

79 Were used 28 herds (504 animals), 15 producing goats and 13 sheep (270 and 234
80 animals, respectively), of both sexes, between three to 48 months-old and without defined
81 breed. In each herd 18 animals were chosen, they should be without anthelmintic treatment for
82 at least three months and presenting $OPG \geq 500$. Subsequently, animals were individually
83 identified and randomly assigned into three groups: group 1, treated with Ivermectine 0,08%,

84 orally, in a single dose of 2,5 mL/ 10 kg l. w.; group 2, treated with Hydrochloride of
85 Levamisole 5%, orally, in a single dose of 1,0 mL/ 10 kg b. w. and group 3, received no
86 anthelmintic treatment, serving as a control group.

87 Fecal samples were individually collected on day zero and ten days after treatments and
88 sent to the Laboratory of Parasitic Diseases of Domestic Animals of the Universidade Federal
89 de Campina Grande (UFCG), Patos - PB, for the fecal analyzes realization. Were performed
90 the counting of Eggs Per Gram of feces (EPG), according to Whitlock & Gordon (1939) and
91 larval culture, according to Roberts & O'Sullivan (1950).

92 The Fecal Egg Count Reduction test (FECR) was performed according to Coles et al.
93 (1992). Subsequently, the data were subjected to one-way variance analysis, and followed by
94 Tukey test at 5% probability. The EPG values were analyzed using logarithmic
95 transformation $\log(x + 1)$, however, are present as arithmetic averages of untransformed
96 values. The analyses were performed using the BioEstat 5.0 Software. The efficacy of the
97 drugs was based on Technical Regulation Ordinance N°. 48/1997 of the Ministério da
98 Agricultura, Pecuária e Abastecimento (MAPA) for chemicals endowed with antiparasitic
99 activity using the following criteria: is highly effective when it reduces more than 98%; 90-
100 98% effective, moderately effective 80-89% and insufficiently active <80% (BRASIL, 1997).

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102 **RESULTS**

103 Was observed a statistical difference ($p < 0,05$) between the goat and sheep anthelmintic
104 treatments (Table 1).

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108 Table 1. Values of EPG e FECR of goat and sheep submitted to anthelmintic treatments in the
 109 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%
Hyd. of Levamisole 5%	5516 ^{Aa}	783 ^{Bc}	86,7%	1521 ^{Aa}	116 ^{Bb}	93,0%
Control	5798 ^{Aa}	5914 ^{Aa}	-	1682 ^{Aa}	1665 ^{Aa}	-

110 Values followed by the same letters maiuscle in lines and minuscule in columns did not
 111 statistically differ ($p>0,05$) – Tukey’s test.

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113 Was observed that the Ivermectine 0,08% EPG did not reduced satisfactorily, especially
 114 in sheep, where this was not statistically different ($p>0,05$) than the control group.
 115 Hydrochloride of Levamisole 5% was the best treatment, differing significantly ($p<0,05$) from
 116 the other groups in EPG values post-treatment in both species.

117 According to Brasil (1997), Ivermectine was insufficiently active in goats (30,9%) and
 118 sheep (24,6%). Hydrochloride of Levamisole already appeared moderately effective in goats
 119 (86,7%) and effective in sheep (93%).

120 The helminths percentages recovered from fecal cultures are described in Table 2.

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

		Control		Ivermectine 0,08%		Hyd. of Levamisole 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

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

133

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

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137 DISCUSSION

138 It was observed that the Ivermectine 0,08% do not satisfactorily reduced the animals
 139 worm burden, with reductions of only 30,9% in goats and 24,6% in sheep. High anthelmintic
 140 resistance was also observed by Lima et al. (2010a), when evaluating the efficacy of
 141 Ivermectine 0.02% in goat herds from Cariri region of Paraíba State, obtaining reduction of
 142 50,1%. Pereira et al. (2008), evaluated this anthelmintic in goats and sheep from Rio Grande
 143 do Norte State, Brazil, showed a reduction of only 14,2% and 20 7% respectively. However,
 144 George et al. (2011) evaluated the Ivermectine in sheep from Trinidad and Tobago getting 95-
 145 97% of FECR, showing up effective. Lima et al. (2010b) in Pernambuco State, Brasil,
 146 observed that Ivermectine showed an efficacy of 67,33% in goats, indicating resistance,
 147 although in sheep presented 100% of efficacy considering highly effective.

148 Several studies have confirmed the resistance of gastrointestinal helminthes of small
149 ruminants to Ivermectine worldwide (LIFSCHITZ et al. 2010; BARTLEY et al. 2012;
150 LEATHWICK et al. 2012).

151 The Hydrochloride of Levamisole 5% showed reductions of 86,7% and 93% for sheep
152 and goats, respectively, similar to which was observed by Rodrigues et al. (2007), when tested
153 this anthelmintic in goats from the Sertão region of Paraíba, with 93.3% of efficiency. Duarte
154 et al. (2012), testing this anthelmintic in Northern of Minas Gerais State, Southeastern Brazil,
155 achieved efficacy ranging from 90% to 100%. However, Leathwick et al. (2012) observed
156 anthelmintic resistance to this anthelmintic (efficacy<70%) in New Zealand sheep and George
157 et al. (2011) observed efficacies between 53% to 81% in sheep from Trinidad and Tobago.

158 The resistance traces to Hydrochloride of Levamisole 5% observed in some farms may
159 be due to its low efficacy against immature stages of nematodes in general (MELO et al.
160 2003).

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

168 Several factors contribute to the development of anthelmintic resistance and
169 consequently inefficiency of antiparasitic drugs. The indiscriminate use of these drugs most
170 often occurs by the producers lack of knowledge, poor management practices and the ease in
171 acquiring these drugs. According to Vilela et al. (2012), the high resistance to anthelmintics
172 observed in studies conducted in semi-arids regions of Northeastern Brazil may be occurs due

173 to the fact that it is a common practice the deworming of all the small ruminant herds four to
174 six times per year.

175 Must be widespread the idea that the anthelmintic control based only on massive herd
176 deworming is a wrong practice. The control must be integrated, where alternative forms of
177 control such as the use of anthelmintic plants, the Famacha[®] method and/ or in the near future,
178 nematophagous fungi, along with synthetic anthelmintics and also associated with good
179 practices of herd management are the solution to minimize the effects of gastrointestinal
180 helminthiasis.

181

182 **CONCLUSION**

183 The goats and sheep gastrointestinal nematodes of the Agreste region of Paraíba State
184 are highly resistant to Ivermectine 0,08%. Resistance traces to Hydrochloride of Levamisole
185 5% were observed in goats.

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