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# Prevalence and risk factors for *Cysticercus tenuicollis* in goats and sheep in Paraíba, northeastern Brazil

Prevalência e fatores de risco para *Cysticercus tenuicollis* em caprinos e ovinos na Paraíba, Nordeste do Brasil

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## Abstract

This study aimed to determine the prevalence and risk factors for *C. tenuicollis* among goats and sheep in slaughterhouses in Paraíba. 390 animals (195 goats and 195 sheep) in the municipalities of Patos and Esperança, Paraíba, Brazil, were inspected between February and May 2014. The prevalence of *C. tenuicollis* was 39% (76/195) in goats and 17.4% (34/195) in sheep. In both species, most of the cysticerci vesicles were located at the omentum and mesentery. The only risk factor found was extensive sheep farming. It can be concluded that *C. tenuicollis* is highly prevalent in small ruminants in Paraíba, being more prevalent in goats than in sheep. Extensively-reared sheep were twice as likely to develop infection by this parasite.

**Keywords:** Goat and sheep farming, cestode, *Taenia hydatigena*.

## Resumo

Objetivou-se determinar a prevalência e os fatores de riscos de *C. tenuicollis* em caprinos e ovinos nos matadouros da Paraíba. Foram inspecionados 390 animais (195 caprinos e 195 ovinos) nos municípios de Patos e Esperança, Paraíba, Brasil, no período de Fevereiro a Maio de 2014. A prevalência de *C. tenuicollis* em caprinos foi de 39% (76/195) e em ovinos de 17,4% (34/195). Os locais mais acometidos por *C. tenuicollis* nas duas espécies foram o omento e o mesentério. O único fator de risco encontrado foi a produção extensiva de ovinos. Pode-se concluir que é alta a prevalência de *C. tenuicollis* em pequenos ruminantes no Estado da Paraíba, sendo mais prevalente na espécie caprina; e que ovinos criados de forma extensiva apresentam duas vezes mais riscos de contraírem uma infecção por este parasita.

**Palavras-chave:** Caprinovinocultura, cestódeo, *Taenia hydatigena*.

## Introduction

The semi-arid region of northeastern Brazil has good potential for goat and sheep-rearing, with favorable environmental conditions and availability of different types of forage, given that most of these herds are raised extensively. Goat and sheep farming in Paraíba is accessible for producers, since the acquisition of animals can be funded through government programs (ANDRADE, 2007). There is high meat demand for trade, which is a source of income for small producers. However, despite the large population of small ruminants in northeastern Brazil, the production rates can be considered low for a variety of reasons, including the presence of parasitic diseases (AMARANTE, 2009).

*Cysticercus tenuicollis* is a metacestode of *Taenia hydatigena*, for which the definitive hosts are dogs and wild canids. Its intermediate hosts are mainly goats, sheep, pigs, cattle, horses and deer. The adult form *T. hydatigena* releases eggs into the feces of definitive hosts, thus facilitating intake by ruminant animals while grazing. Once ingested, the eggs hatch in the small intestine and start to migrate to other visceral organs. This may cause appetite loss, weight loss and, hence, reduction of meat and milk production (ORYAN et al., 2012).

Infection with *C. tenuicollis* favors infection and growth of pathogenic microorganisms that can cause necrotic hepatitis, which gives rise to economic losses associated with reduced productivity among the affected animals and condemnation of damaged organs (POPOVA & KANCHEV, 2013). In high

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infections, mortality may occur, as described by Scala et al. (2016) in central Sardinia, Italy, where an acute outbreak of *T. hydatigena* cysticercosis occurred, causing mortality in 5 of 21 (23.8%) female lambs. In Greek slaughtered sheep, the infection level due to *C. tenuicollis* was 29.4% (CHRISTODOULOPOULOS et al., 2008). The infection levels in small ruminant carcasses in Brazil are high. In Ceará, Brazil, the rate was 32% (SOARES et al., 2012). The State of Paraíba, Brazil, has 167,477 farms that account for a total of 566,576 goats and 501,362 sheep (IBGE, 2006, 2015). In Paraíba, there are no studies reporting the infection levels due to *C. tenuicollis* in small ruminants.

According to Kouam et al. (2014), research directed towards the risk factors that lead to development of a given disease or pathogen are of the utmost importance, since this has the aims of helping to formulate control strategies. Therefore, the aim of the present study was to determine the prevalence and the identification of some putative risk factors for *C. tenuicollis* in goats and sheep from the municipal slaughterhouses of the municipalities of Patos and Esperança, Paraíba, Brazil.

## Materials and Methods

This study was conducted in two public municipal slaughterhouses of the municipalities of Patos and Esperança, which are located in Sertão and Agreste mesoregions of Paraíba, respectively. These slaughterhouses were selected because they are authorized by the municipal inspection service to slaughter up to 15 small ruminants per day.

The study was carried out from February to May 2014. Samples were collected during 10 visits to each slaughterhouse. A thorough inspection of the abdominal cavity was performed to determine the preferential location of cysticerci vesicles. Inspection was directed towards the omentum, liver, gallbladder and other abdominal organs. All animals slaughtered in the visit day were inspected. In total, 390 animals (195 goats and 195 sheep) were evaluated for the presence of *C. tenuicollis*.

The samples were analyzed in accordance with an observational study design. Sample analysis was done especially on the days on which it was possible to follow up the slaughter of small ruminants, with the possibility of analysis of carcasses and offal.

Immediately after each animal had been slaughtered, specimens of *C. tenuicollis* that were found were removed carefully with the aid of scissors and tweezers. They were then stored in properly identified plastic bags, and were transported in ice, in styrofoam boxes, to the Laboratory for Parasitic Diseases of Domestic Animals (LDPAD), of the Federal University of Campina Grande (UFCG), for macroscopic analysis followed by confirmation of the species.

In order to assess risk factors, a semi-structured questionnaire was applied individually to all the owners of the 390 slaughtered animals. The questionnaire was composed of five fields: two for identification of the farm and the animals; one regarding the management system [including the production system (intensive, extensive and semi-extensive), the number of animals in the farm and the existence of dogs in the farm]; another on the prevalence of *C. tenuicollis* in the farm; and the last field of the

survey regarding the deworming practices, the total area of the farm and the flock size.

## Statistical analysis

The number of samples analyzed was calculated taking into account a 50% expected prevalence of *C. tenuicollis* and a 95% confidence interval, assuming a statistical error of 10% (THRUSFIELD, 2007).

Possible associations between the presence of *C. tenuicollis* and the variables analyzed from the epidemiological questionnaire were ascertained using the chi-square test, in the BioEstat 5.0 software (AYRES et al., 2003).

## Ethics committee

This study was approved by the Research Ethics Committee of UFCG under protocol number 178/2014 CEP.

## Results

A total of 390 animals were evaluated in the two slaughterhouses. Goats inspected in the slaughterhouse of Patos came from 16 herds while those at Esperança originate from six herds. Sheep evaluated in the slaughterhouse of Patos originated from ten herds and those at Esperança were from seven herds. All the goats and sheep represented crossbreds.

The mean age at slaughter was two years (ranging from eighth months to four years) for both goats and sheep. The study covered 117 males and 78 females for goats and 102 males and 93 females for sheep.

This study evidence an estimated prevalence of *C. tenuicollis* of 39% (76/195) in goats and 17.4% (34/195) in sheep. The percentage of infection among the goats was statistically higher than that of the sheep ( $p < 0.05$ ).

The percentages of *C. tenuicollis* vesicles by location in goats and sheep are described in Table 1. A total of 153 vesicles were retrieved from 76 positive goats and 66 vesicles from 34 positive sheep. The most prevalent abdominal locations for *C. tenuicollis* were similar in goats and sheep: the omentum [41.8% (64/153) and 44% (29/66), respectively], the mesentery [37.3% (57/153) and 28.8% (19/66), respectively] and the abomasum [7.2% (11/153) and 9.1% (6/66), respectively]. The average weights of cysticerci presented in the positive animals were 27 g  $\pm$  5.8 g in goats and 41.3 g  $\pm$  23 g in sheep.

The intensity of *C. tenuicollis*, estimated from the number of vesicles presented in the carcass, was wider in goats than in sheep. In goats, 21% (16/76) of positive carcasses presented one vesicle, 59.2% (45/76) presented two vesicles, 17.1% (13/76) three vesicles, and 2.7% (2/76) four vesicles. In sheep, 29.4% (10/34) of the positive carcasses presented one vesicle, 47% (16/34) two vesicles, and 23.6% (8/34), three vesicles. In only one goat the liver presented a major granulomatous lesion that received full condemnation. In the infested viscera of other animals, the

lesions were caused by the parasite attachment and received partial condemnation.

The characteristics of the herds, farm and management and the presence of the definitive host were analyzed with regard to development of *C. tenuicollis* in goats and sheep (Table 2). In this study, the parameters tested did not significantly affect ( $p < 0.05$ ) the occurrence of *C. tenuicollis* in goats. In sheep, only the parameter “extensive management” significantly affected the occurrence of cisticercosis ( $p < 0.05$ ), which showed an odds ratio of 2.34 (CI 95%). Sheep raised extensively were twice as likely to present infection.

## Discussion

The prevalence of *C. tenuicollis* found in this study (39% in goats and 17.4% in sheep) is in line with research carried out by Soares et al. (2012) in the back country of Ceará, Brazil. These

authors observed high prevalence of *C. tenuicollis*, of 26.2% in goats and 35.2% in sheep, and also did not observe any significant differences ( $p > 0.05$ ) in the quantity of cysticerci, in relation to the sex or age of the animals. In Ethiopia, a study by Wondimu et al. (2011) showed *C. tenuicollis* was present in 63.9% of the goats and 56.8% of the sheep inspected, and that the results presented led to estimated economic losses of US\$ 65,269.89 per year.

In this study, the site of highest prevalence of *C. tenuicollis* was the omentum: 41.8% of the total vesicles were infecting this location in goats and 44% of the sheep were infected at that site. The mesentery was the site with the second highest prevalence. Similar results were obtained by Al-Bayati et al. (2012) in Iraq; Wondimu et al. (2011) in Ethiopia; and Payan-Carreira et al. (2008) in Portugal, with highest prevalence in the omentum, followed by the mesentery.

The risk factors found in this study were related to the type of rearing system. Sheep raised extensively were twice as likely to be

**Table 1.** Number and location of *Cysticercus tenuicollis* vesicles in goats and sheep in the state of Paraíba, Brazil.

	Infected locations [n/(%)]								
	Oment.	Mes.	Abom.	Rumen	Liver	Carc.	Bl.	S.I.	L.I.
Goats	64 (41.8)	57 (37.3)	11 (7.2)	9 (5.9)	8 (5.2)	1 (0.65)	0 -	2 (1.3)	1 (0.65)
Sheep	29 (44)	19 (28.8)	6 (9.1)	5 (7.6)	3 (4.5)	0 -	2 (3)	2 (3)	0 -

Oment – Omentum; Mes. – Mesentery; Abom. – Abomasum; Carc. – Carcass; Bl. – Bladder; S.I. - Small Intestine; L.I. - Large Intestine.

**Table 2.** Univariate analysis on the characteristics of the animals and the farms from which they originated, in relation to risk factors for development of *Cysticercus tenuicollis* in goats and sheep in the state of Paraíba, Brazil.

Variable	Number of goats	<i>C. tenuicollis</i> goats (%)	P	Number of sheep	<i>C. tenuicollis</i> sheep (%)	P
Sex	97	40 (41.2)	0.619	97	14 (14.4)	0.362
Male	98	36 (36.7)		98	20 (20.4)	
Female						
Age						
< 1 year	111	37 (33.3)	0.119	116	22 (19.0)	0.753
> 1 year < 2 years	70	34 (48.6)		63	10 (15.9)	
> 2 years	14	5 (35.7)		16	2 (12.5)	
Management						
Extensive	30	16 (53.3)		26	9 (34.6)*	0.023
Semi-intensive	165	60 (36.4)	0.121	169	25 (14.8)	
Presence of dogs						
No	56	23 (41.1)		56	8 (14.3)	
Yes	139	53 (38.1)	0.825	139	26 (18.7)	0.598
Dewormed animals						
No	61	25 (41.0)		57	10 (17.5)	
Yes	134	51 (38.1)	0.818	138	24 (17.4)	1.000
Farm area						
Up to 10 ha	60	23 (38.8)	0.455	60	10 (16.7)	0.970
11 to 20 ha	26	13 (50.0)		24	4 (16.7)	
Over 20 ha	109	40 (40.7)		111	20 (18.0)	
Size of the herd						
30 animals	12	7 (58.3)	0.262	14	3 (21.4)	
31-100	107	43 (40.2)		105	17 (16.2)	-
Over 100	76	26 (34.2)		76	14 (18.4)	

\*The variable of sheep management significant at  $p < 0.05$ .

infected by *C. tenuicollis*. The high rates of infection among animals that are reared extensively probably result from the longer periods of time for which these animals are exposed to environments in which infected dogs (definitive hosts) are present.

Most of these small-ruminant farms had dogs. It is known that the best way to prevent *C. tenuicollis* is by deworming definitive hosts. However, none of the owners said they had conducted deworming among their dogs and all of these dogs had free access to the pastures, favoring the persistence of the livestock infection. In addition, stray dogs can circulate for several properties, a source of environmental contamination with *T. hydatigena* eggs, even in properties without dogs. In the region, the problem is aggravated by the habit of feeding dogs with raw viscera, especially in properties that perform illegal slaughter. In addition, dogs may have access to the carcass of dead animals on properties.

## Conclusion

It was concluded that there is high prevalence of *C. tenuicollis* in small ruminants in the state of Paraíba and that this parasite is more prevalent in goats than in sheep. Extensive rearing is considered to be a risk factor for development of this parasite in sheep.

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