

# Cysticercus Tenuicollis in Visceral Organs of Goats and Sheep in Uganda: A Case Study in Lira Municipal Abattoir

Joseph Magala<sup>1\*</sup>, Barnabas Mudde<sup>2</sup>, Patrick Abel Mawadri<sup>3</sup>, Williams Guma<sup>4</sup>, Sylvester Dickson Baguma<sup>4</sup>, Patrick Olango Okot<sup>5</sup>, Jolly Akullo<sup>6</sup>

<sup>1</sup>National Agricultural Research Organisation, Kachwekano Zonal Agricultural Research and Development Institute, Kabale, Uganda

<sup>2</sup>National Agricultural Research Organisation, Ngetta Zonal Agricultural Research and Development Institute, Lira, Uganda

<sup>3</sup>College of Veterinary Medicine, Animal Resources and Biosecurity, Makerere University, Kampala, Uganda

<sup>4</sup>National Agricultural Research Organisation, Bulindi Zonal Agricultural Research and Development Institute, Hoima, Uganda

<sup>5</sup>Norwegian Refugee Council West-Nile Office, Yumbe, Uganda

<sup>6</sup>Faculty of Agriculture and Animal Sciences, Arapai Campus, Busitema University, Tororo, Uganda

Email: \*magalajoseph37@gmail.com

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## Abstract

*Cysticercus tenuicollis* is a metacestode stage of *Taenia hydatigena* residing in the visceral organs of small ruminants and its effects cause economic losses due to condemnation of visceral organs in slaughterhouses. This study reports on the prevalence of *Cysticercus tenuicollis* in small ruminants slaughtered in Lira Municipal Abattoir. A total of 70 sheep and 70 goats were sampled and examined after slaughter for the presence of *Cysticercus tenuicollis* in the visceral organs using standard meat inspection procedures. An abattoir data collection sheet was used to record data, which was then analysed in SPSS version 20. The study revealed 51.4% of goats and 68.6% of sheep to be infested with *Cysticercus tenuicollis*. Following the district of origin for the small ruminants, Otuke district had the highest prevalence of the parasite (82.6%), followed by Kole (72.4%), Alebtong (66.7%), Apac (59.4%) and Lira (31.4%). *Cysticercus tenuicollis* was more frequently seen in the intestines (57.8%) of sheep and goats than in any other visceral organs. The liver had a prevalence of 20.7%, the lungs 17.8%, the kidneys 3.5% and the fetal sac; (15.7%) in goats and (12.9%) in sheep. *Cysticercus tenuicollis* was detected in 68.8% of females and 58.8% of male small ruminants. It is recommended to routinely deworm goats and sheep by farmers most especially in districts with the highest prevalence of *Cysticercus tenuicollis* infestation. The sale of the condemned parts of sheep and goats and the feeding of dogs on these contaminated materials should be stopped forthwith. It is also being suggested that a national study be

carried out to determine the prevalence and economic impact of *Cysticercus tenuicollis* in small ruminants.

## Keywords

*Cysticercus tenuicollis*, Goats and Sheep, Abattoir

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## 1. Introduction

The population of goats and sheep in Africa is 373 million and 165 million, respectively, representing approximately 40% and 32% of the world's total. Within Africa, the distribution of small ruminants varies widely, with a higher concentration found in dry areas than in humid areas. Despite their higher contribution to the total world livestock population, sheep and goats produce only about 16% of the world's meat [1]. Small ruminants are important domestic animals in the tropical animal production systems in East Africa [2]. Uganda is endowed with 16 million goats and 4.5 million sheep [1]. About 80% of rural communities in Uganda have good potential for harvesting and utilising available resources for rearing the local breeds of small ruminants for meat towards poverty alleviation in the form of providing cash income and food security to farmers [3].

However, many constraints to small ruminant production remain, owing to limited access to animal health products and services. Other production challenges for small ruminants include a lack of high-quality grazing due to bush encroachment and urbanization, increasing drought episodes, ineffective disease control, and limited market access [2]. Parasites and diseases generate significant financial waste as a result of direct and indirect economic losses, and it is a major public health concern [4]. Among the parasitic burden in small ruminants is *Cysticercus tenuicollis*, this is a metacestode stage of the adult internal parasite of dogs called *Taenia hydatigena*. Ruminants are the intermediate hosts of *Cysticercus tenuicollis* while canines are the definitive hosts [4]. This metacestode resides inside ruminant animals as an intermediate host. During carcass inspection, they are typically observed as loosely filled cysts with transparent fluid found in the abdominal viscera attached to the cavities of the abdominal viscera and livers of infected animals. *Cysticercus tenuicollis* has an important economic loss due to the condemnation of visceral organs in slaughterhouses [5]. The transmission of *Cysticercus tenuicollis* occurs most commonly in environments characterized by poor sanitation, poor livestock husbandry practices, and a high abundance of stray dogs. Traditional husbandry practices, inadequate meat inspection and management, and poor control policies favour transmission of the parasite [6]. Significant losses occur arising from organ condemnation due to hydatid and *C. tenuicollis* cysts in small ruminants in developing countries, where there are low standards of sanitation, unregulated home slaughter, and close contact between people and animals, especially in pastoral communities [7].

Although surveys on the prevalence of livestock parasite infestations have been reported in different parts of Uganda, there are no published studies on *Cysticercus tenuicollis*. Studies conducted in abattoir surveys to determine the prevalence of parasitic infestations in ruminants have focused on cases such as porcine cysticercosis, hydatidosis, fasciolosis, and their economic burden [8]. This has made *Cysticercus tenuicollis* a neglected infestation, with its effects unquantified in Uganda. The current study aims to determine the prevalence of Cysticercosis tenuicollis in sheep and goats in northern Uganda as well as to explore the influence of district of origin, sex, age, and visceral organ infestation.

## 2. Materials and Methods

### 2.1. Study Area

The study was conducted at the Lira Municipal Abattoir, Lira District, Northern Uganda. The district is located in the North Eastern part of the cattle corridor and is characterized by: a high livestock population, a weak livestock industrial sector, inadequate provision of extension services, traditional livestock husbandry practices, declining soil fertility, environmental degradation and droughts [9] which collectively contribute to livestock diseases and infestations. It covers a total area of 512 sq miles (1326 km<sup>2</sup>) with latitude and longitude of 021456°N, 32.5400°E respectively. Annual rainfall varies between 1200 - 1600 mm and it has an average minimum and maximum temperature of 18°C-30°C respectively.

### 2.2. Study Population

The study population was goats and sheep slaughtered in Lira municipal abattoir, which originate from Lira and the neighboring districts such as Apac, Otuke, Kole and Alebtong. The animals were brought into the abattoir from the livestock farmers and markets located in the above-mentioned districts.

### 2.3. Study Design

A Longitudinal-cross sectional study was conducted to determine the prevalence of *Cysticercus tenuicollis* in the Lira Municipal Abattoir. The study was conducted in the months of October 2014 to January 2015. The study involved routine meat inspection of goats and sheep slaughtered in the abattoir, as suggested by [10]. The carcasses of these goats and sheep were thoroughly inspected for the possible presence of *Cysticercus tenuicollis* cysts.

### 2.4. Sampling and Sample Size Determination Methods

The sample size was determined using the formula as described by [11], at a 95% confidence interval. The limited number of sheep made the study longitudinal. All the sheep that were presented for slaughter were considered for the study. The number of goats inspected was equal to the number of sheep slaughtered in a day. This selection was considered during ante-mortem inspection.

$$n = \frac{1.96^2 * P_{\text{exp}} (1 - P_{\text{exp}})}{d^2}$$

where,  $n$  = required sample size,

$P_{\text{exp}}$  = expected prevalence, 10% [12],

$d^2$  = desired absolute precision. 5% (0.05<sup>2</sup>),

$$3.8416 * 0.10 * 0.9 / 0.0025$$

$n = 138.4$  goats and sheep.

Therefore, 140 small ruminant animals; 70 goats and 70 sheep were considered to be the sample size for this study.

## 2.5. Data Collection Method

Data collection was done using abattoir data collection sheets. Livestock movement permits were key in revealing the district of origin for the small ruminants. Photos of infested organs were taken for record-keeping purposes and future reference. This gave a visual representation of the existing situation at the abattoir (Figure 1).



**Figure 1.** Photo of *Cysticercus tenuicollis* infestation on the mesentery of the intestines in slaughtered sheep.

## 2.6. Data Analysis Method

The information gathered was entered into a Microsoft Excel 2010 spreadsheet. The data was analyzed using SPSS version 22. The influence of risk factors on the infestation was compared using the Chi-square test ( $\chi^2$ ) and p-values. Chi-square ( $\chi^2$ ) statistical test was applied to determine the associations between the various potential risk factors like age and sex, and the prevalence of cysticercus cysts in the examined animals. A statistically significant association among variables was considered to exist when P-value was less than 0.05 ( $P < 0.05$ ).

## 2.7. Data Presentation Method

Data was presented in tabular and graphical forms for simpler classification of the prevalence of the parasite and the organ distribution of cysts per predilection site. A pie chart was used to further show the prevalence of *Cysticercus tenuicollis* in

female and male small ruminants.

### 3. Results

#### 3.1. Overall Prevalence of *Cysticercus tenuicollis* in Small Ruminants Slaughtered in Lira Municipal Abattoir

Out of the 140 small ruminants sampled, 84 were seen infested with the *Cysticercus tenuicollis* parasite leading to an overall prevalence of 60%.

#### 3.2. Variation of Prevalence of *Cysticercus tenuicollis* with Species of Small Ruminants

Out of 70 goats and 70 sheep sampled, 36 and 48 animals were infested with the parasite revealing a prevalence of 51.4% for goats and 68.6% for sheep respectively. There is a significant relationship ( $P < 0.05$ ) between infestation and species of small ruminants (Table 1).

**Table 1.** Prevalence of *Cysticercus tenuicollis* with species of small ruminants.

Species	No. of examined animals	No. of infested animals	Prevalence (%)	$\chi^2$	P-value
Goats	70	36	51.4	4.286	0.038
Sheep	70	48	68.6		
Total	140	84			

#### 3.3. Variation of the Prevalence of *Cysticercus tenuicollis* with the Age of Small Ruminants

The prevalence by age revealed 68.8% in small ruminants of 1 - 2 years, 63.5% in those of 3 years and 54.1% in those of 4 years. There was no significant relationship ( $P > 0.05$ ) between infestation and age of small ruminants (Table 2).

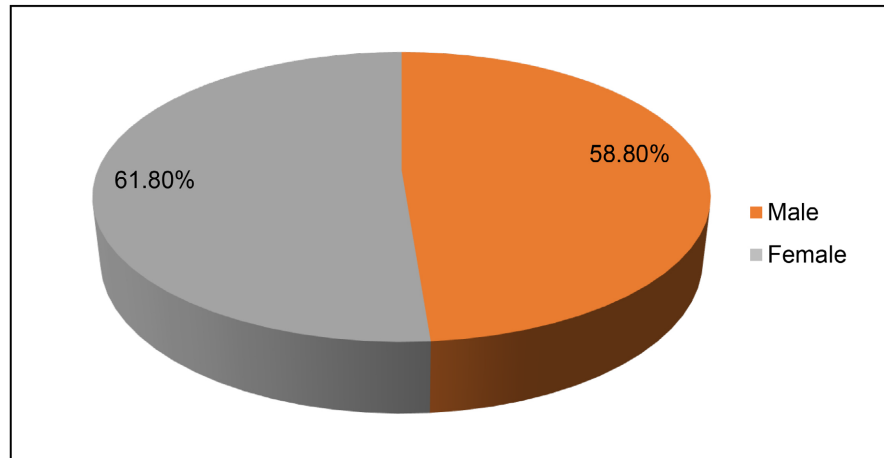
**Table 2.** Prevalence of *Cysticercus tenuicollis* with age of small ruminants.

Age (Years)	No. of examined animals	No. of infested animals	Prevalence (%)	$\chi^2$	P-value
1 - 2	16	11	68.8	1.569	0.210
3	63	40	63.5		
4	61	33	54.1		

#### 3.4. Variation of the Prevalence of *Cysticercus tenuicollis* with the Sex of Small Ruminants

Out of the 84 small ruminants infested with *Cysticercus tenuicollis*, 34 were females and 50 were males revealing the prevalence of 61.8% and 58.8% respectively.

The study revealed no significant relationship ( $P > 0.05$ ) between *Cysticercus tenuicollis* infestation and the sex of small ruminants (**Figure 2**).



**Figure 2.** Showing prevalence of *Cysticercus tenuicollis* with sex of small ruminants.

### 3.5. Variation in Prevalence of *Cysticercus tenuicollis* with District of Origin of Small Ruminants

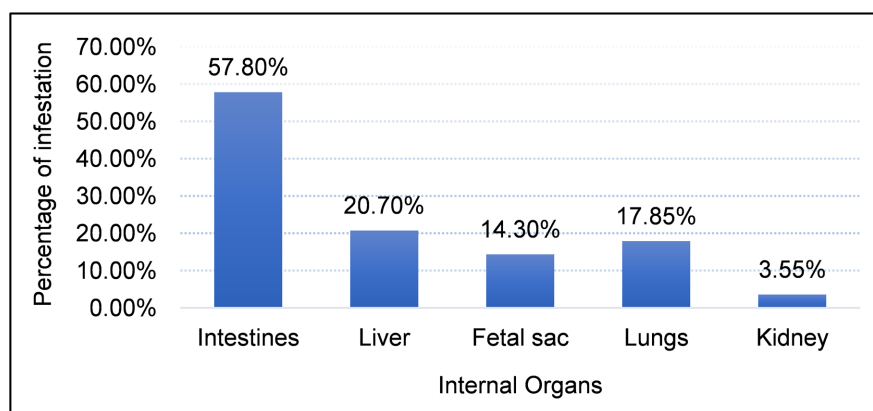
The study results showed Otuke district to be with the highest prevalence of *Cysticercus tenuicollis* 82.6%, Kole 72.4%, Alebtong 66.7%, Apac 59.4% and 31.4% from Lira. There was a significant relationship between infestation and origin of small ruminants ( $P < 0.05$ ) (**Table 3**).

**Table 3.** Prevalence of *Cysticercus tenuicollis* with a district of origin of small ruminants.

District of origin	No. of examined animals	No. of infested animals	Prevalence (%)	$\chi^2$	P-value
Lira	35	11	31.4		
Apac	32	19	59.4		
Kole	29	21	72.4	19.0	<b>0.001</b>
Otuke	23	19	82.6		
Alebtong	21	14	66.7		

### 3.6. Distribution of *Cysticercus tenuicollis* in the Internal Organs of the Small Ruminants

*Cysticercus* cysts showed greater presence in the intestines (57.80%), than the Liver (20.70%), Lungs (17.85%), fetal sac (14.30%), and the Kidney (3.55%) (**Figure 3**). Between species, sheep showed a higher prevalence of *Cysticercus tenuicollis* for all organs, except for the fetal sac. This further explains the findings in section 4.2 where it was reported that sheep had a higher prevalence of 68.8% when compared to goats (51.40%).



**Figure 3.** The distribution of *Cysticercus tenuicollis* in the internal organs of small ruminants.

#### 4. Discussion

The overall prevalence of *Cysticercus tenuicollis* in small ruminants was 60%. A similar prevalence (60.3%) was reported in Ethiopia [13]. Higher prevalence 71.8% was reported in Maiduguri, North Eastern Nigeria [14]. However, a lower prevalence of 36.3% was recorded in Southern Iran [15], and 15.4% in Kerman in Iran [16]. The relatively higher prevalence of *C. tenuicollis* recorded in the study could be associated with the degree of pasture contamination and the way of raising and open feeding methods of small ruminants, including communal grazing, tethering which favour the interaction and transmission cycle between ruminants and dogs [13] [17].

Species wise, the study revealed a prevalence of *C. tenuicollis* to be 68.6% in sheep and 51.4% among goats. Higher prevalence of 71.9% in goats was reported in Maiduguri Eastern Nigeria [14], 55.1% in Southern Iran [15] and 63.9% in Ethiopia [13]. Lower prevalence (18.04%) were reported in goats in Kerman abattoir in Iran [16]; and 46.6% in Debrezeit [18]. The prevalence of *C. tenuicollis* recorded in the current study could be attributed to variations in the degree of pasture contamination and extensive grazing favour the transmission cycle between ruminants and dogs. [13] and [17] attributed the high prevalence in goats (63.9%) to the extensive rearing system which allowed the animals to pick eggs on pastures. The prevalence of *C. tenuicollis* in the current study (68.6%) in sheep is close to the prevalence (65.6%) reported in Turkey [19] [20] and 63.9% in Ethiopia [13]. Higher prevalence of 71.6% was reported in Eastern Nigeria [14]. Lower prevalence of 12.8% and 12.13% were found in sheep from Iran [16] and Turkey's Malatya province [20]. The lower infestation rate of the goats as opposed to sheep in this study could be attributed to their grazing characteristics. Goats browse by the eating leaves of short trees and shrubs, which are rarely soiled by dog faeces, reducing the chances of infestation [16].

The current study found that younger small ruminants 1 - 2 years were slightly more infested (68.8%) than the adults of 3 years (63.5%) and 4 years (54.1%). Other studies have found a prevalence of 42.5% in small ruminants over 3 years

old, 33.5% in kids and lambs in Ethiopia [21]; 49.6% in adult goats and sheep, 38.6% in young goats and sheep [18] and [20] in Turkey reported adult animals to be more infested than younger ones. The high prevalence of young small ruminants observed in the current study could be attributed to the method of grazing (tethering) where the adult animals and the kids are left to graze in the same place. Also, the young small ruminants have more close contact with the shepherded dogs leading to the ingestion of the eggs of *T. hydatigena*. However, the lower infestation in adult small ruminants is attributed to the increased immunity resulting from the consumption of a small number of eggs.

The current study revealed female small ruminants (61.80%) were more infested than males (58.80%). *Cysticercus tenuicollis* infestation and sex of small ruminants are in agreement with the previous findings [20] and [14]. The slightly higher prevalence in the current study in female small ruminants could be attributed to the greater demand for feeds needed to meet the nutrient requirement during gestation hence pre-disposing them to the infestation.

The prevalence of *C. tenuicollis* with respect to the district of origin of small ruminants revealed an infestation rate of (82.6%) with Otuke, (72.4%) Kole, (66.7%) Alebtong, (59.4%), Apac (59.4%) and (31.4%) Lira. This trend in infestation could be attributed to management practices like communal feeding (grazing) and management systems which increase the interaction and exposure of the small ruminants to freely roaming stray dogs on grazing land and the deep-ingrained habit of feeding dogs with trimmed and condemned slaughter materials could have been an important risk factors. [13] advanced similar arguments when their study revealed a higher prevalence of *C. tenuicollis* in highland goats and sheep (68.1%) than those in lowland (56.6%). Their study attributed the findings to grazing or feeding and management practices in highland areas and the close association between goats and dogs in this area. The lower prevalence in both sheep and goats from the lowland was attributed to environmental conditions such as high temperature and low humidity, both of which are detrimental to the survival of *T. hydatigena* eggs.

The internal organs revealed a higher prevalence of *C. tenuicollis* attached to the intestines (57.80%) the liver (20.70%), lungs (17.85%), fetal sac (14.30%), and kidneys (3.55%). The obtained sequences of the cysts in this study are consistent with findings of [16] and [22]. There was a greater presence of the parasite in the mesentery, which is probably better explained by its lifecycle. [16] reported that metacestodes migrate through the hepatic parenchyma to the peritoneal cavity maturing to become attached among other surfaces. [20] cites the fact that the mesentery covers a larger surface area in the peritoneal cavity as a possible reason for the greater presence of the parasite in this region.

#### 4.1. Study Limitations

1) The study only based on routine post-mortem inspection to determine the prevalence of infestations. The use of molecular methods could reveal in-depth



findings that the eyes could miss.

2) The number of sheep presented in the abattoir was few on a daily basis which lengthened the study period.

3) The limited number of sheep presented in the abattoir saw a selection of sheep for the study following a census.

#### 4.2. Avenues for Future Research

1) The study recommends future studies with a bigger sample size in different districts and locations in Uganda.

2) Encourage investors to establishment of abattoirs and selling points for mutton to enable and facilitate studies with sheep meat towards safety of humans, animals and environment.

3) A study on the economic losses caused by infestations of organs by parasites in goats and sheep slaughtered in the abattoir should be conducted.

### 5. Conclusion

The study aimed to determine the prevalence of *Cysticercus tenuicollis* in goats and sheep slaughtered in Lira Municipal abattoir. The study revealed a prevalence of 60% in small ruminants slaughtered in Lira Municipal Abattoir. Sheep exhibited a significantly higher infestation (68.6%) than goats (51.4%). Prevalence was not significantly affected by the age and sex of the small ruminants. The district of origin however had a significant influence on infestation. The predominant site of infestation with *Cysticercus* cysts was the intestines with a prevalence of (57.80%), Liver (20.70%), the fetal sac in female animals (14.30%), Lungs (17.85%), and Kidney (3.55%). Among all the small ruminants infested with the parasite, at least each possessed a *cysticercus* cyst on the intestines. The research also observed that condemned abattoir materials were being uncontrollably sold to dog owners. It's being concluded that this practice in the face of a significantly high prevalence of *Cysticercus tenuicollis* has exacerbated infestation and contributed to the maintenance of the parasite's life cycle between the intermediate host (small ruminants) and the final host (dogs).

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### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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