

CYSTICERCOSIS IN SMALL RUMINANTS SLAUGHTERED IN ASWAN SLAUGHTERHOUSE, EGYPT

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ABSTRACT

The aim of the present study was to determine the prevalence, organ distribution, morphological characters and economic importance of *Cysticercus ovis* and *Cysticercus tenuicollis* in sheep and goats. A total of 669 sheep and 484 goats slaughtered at Aswan Slaughterhouse were carefully examined for these metacestodes. *Cysticercus ovis* was detected (1.94%) from slaughtered sheep. *Cysticercus tenuicollis* was found (13.3%) in sheep and (24.2%) in goats. The prevalence of both *C. ovis* and *C. tenuicollis* was higher in females than males and their prevalence was higher in older animals compared to the younger ones. For *Cysticercus ovis*, the highest infection was found in spring while the highest seasonal infection rate of *Cysticercus tenuicollis* in slaughtered sheep and goats was noted in autumn season. The infection with *C. ovis* was only found in the heart, while *C. tenuicollis* in slaughtered sheep and goats was found mainly in the omentum. These results suggest that the high prevalence of the metacestodes infection in this area is a great concern for both medical and veterinary authorities to design therapeutic and preventive programs to overcome this problem.

Key words: Metacestodes, small ruminants, Aswan, Zoonosis.

INTRODUCTION

Metacestodes are the larval stages of the tapeworms inhabiting in intermediate hosts. The Middle East, southwestern Asia and the Mediterranean coast were considered of high endemic area for metacestodes infection. One of the most common metacestodes which found in infected slaughtered sheep is *Cysticercus ovis* which may lead to a disease in infected sheep called "sheep measles". *Cysticercus ovis* is the intermediate larval stage of canid tapeworm, *Taenia ovis*. The adult tapeworm lives in the intestine of domestic dogs and wild canids (Paula, 2009).

Another important and common metacestodes is *Cysticercus tenuicollis* which is the larval stage of *Taenia hydatigena*, a tapeworm of dogs and wild carnivores. The Cysticerca are found in the liver and on the peritoneum in sheep and also in other ruminants including wild ones and pigs. It is called also "long-necked bladder worm". The Cysticerca are most commonly found attached to the omentum, mesentery, live and peritoneum (Kaufmann, 1996).

The prevalence of infection is considerably high in the world in some countries even more than 85% of sheep population was found to be infected with this metacestode (Garcia-Marin and Peris-Palau, 1987). The present study was designed to study the prevalence and organ distribution of these metacestodes in slaughtered sheep and goats in Aswan Governorate, southern Egypt. Also the seasonal, age and sex relationship was determined. In addition to the histopathological and Scanning electron microscopy of cysticercus were studied.

MATERIALS AND METHODS

Study area: This study was done from August 2015 to July 2016 in Aswan slaughterhouses of Aswan Governorate, southern Egypt.

Animals and post mortem examination: A total of 669 sheep and 484 goats carcasses of both sexes and of different age ranges slaughtered at Aswan slaughterhouse were examined. Visual inspection of the omentum, mesentery, peritoneal cavity, liver, lungs, kidneys, spleen, striated muscles, heart and subcutaneous area of each carcass was done for the presence of *C. ovis* and *C. tenuicollis*. Cysts were removed from the condemned organs by careful dissection from surrounding tissues without injuries to the wall of cysts. All the detected larval cestodes

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were collected in separate cellophane bags, then labeled and carried to the laboratory of Parasitology Department, Faculty of Veterinary Medicine, Aswan University in ice box container for further examination. Cysts wash thoroughly with distilled water and then keep in formalin 10% for histopathological examination, some cysts were used to the macroscopic and unstained process. Some cysts were kept in 5% cold buffered glutaraldehyde for the examination with scanning electron microscope. This examination was applied for studying the larval cestodes distribution and cyst characterization according to their location in different organs.

Data analysis:

Data were collected and entered into the computer using SPSS (Statistical Package for Social Science) program for statistical analysis. Data were entered as numerical or categorical, as appropriate. Two types of statistics were done: Descriptive statistics: Qualitative data were expressed as frequency and percent at 95% confidence interval (95% CI).

Analytical statistics: Chi-square test (X^2) were used to measure the association between qualitative variables. P (probability) value considered to be of statistical significance if it is less than 0.05.

RESULTS

I. The infection rate and predilection seats of metacestodes in slaughtered animals:

Cysticercus ovis was detected (1.94%) from slaughtered sheep in Aswan slaughterhouse. The survey of slaughtered goats and sheep revealed a high infection rate with *Cysticercus tenuicollis* in goats (24.2%) and was double than that of sheep (13.3%). Females of slaughtered sheep were more susceptible for *C. ovis* (2.63%) than males (1.59%). Moreover, Females of slaughtered sheep and goats were more susceptible for *C. tenuicollis* (28.5%) and (46.7%) than males (5.4%) and (20.9%), respectively. Sheep infected with *C. ovis* in young and aged animals were (1.18%) and (3.26%), respectively. Sheep and goat infected with *C. tenuicollis* in young and aged animals were (12.03%) and (15.5%), (24.1%) and (25%), respectively Table (1).

Table 1: The infection rate of metacestodes in slaughtered animals.

Metacestode	Sp.	Inspected/ Infected (%)	Aswan abattoir	M	F	X^2	P-value	Young	Adult	X^2	P-value
<i>C. ovis</i>	Sheep	Ins.	669	441	228	0.205	0.651	424	245	1	0.312
		Inf. (%)	13 1.94%	7 1.59%	6 2.63%			5 1.18%	8 3.26%		
		Ins.	669	441	228			424	245		
<i>C. tenuicollis</i>	Sheep	Ins.	669	441	228	19.2	<0.0001	424	245	0.157	0.692
		Inf. (%)	89 13.3%	24 5.4%	65 28.5%			51 12.03%	38 15.5%		
		Ins.	669	441	228			424	245		
<i>C. tenuicollis</i>	Goats	Ins.	484	424	60	1.2	0.549	448	36	0.027	0.869
		Inf. (%)	117 24.2%	89 20.9%	28 46.7%			108 24.1%	9 25%		
		Ins.	484	424	60			448	36		

For *Cysticercus ovis* in sheep, the highest infection was found in spring (4.1%), followed by winter (1.9%) and summer (0.5%). The highest seasonal infection rate of *Cysticercus tenuicollis* in slaughtered sheep and goats was noted in autumn season (21.6%) and (73.7%), followed by winter season (12.4%) and (24.0%), while the lowest infection rate was recorded in spring and summer seasons (11.98% and 23.7%) and (11.6% and 14.3%), respectively Table (2).

Table 2: The infection rate of metacestodes in slaughtered animals in relation to season

Metacestode	Animal Species	Inspected/ Infected (%)	Spring	Summer	Autumn	Winter	X^2	P-value
<i>C. ovis</i>	Sheep	Inspected	192	180	88	209	3.06	0.382
		Infected (%)	8 (4.1%)	1 (0.5%)	0	4 (1.9%)		
		Inspected	192	180	88	209		
<i>C. tenuicollis</i>	Sheep	Inspected	192	180	88	209	6.05	0.109
		Infected (%)	23 11.98%	21 (11.6%)	19 (21.6%)	26 (12.4%)		
		Inspected	192	180	88	209		
<i>C. tenuicollis</i>	Goats	Inspected	135	182	38	129	99.3	<0.0001
		Infected (%)	32 (23.7%)	26 (14.3%)	28 (73.7%)	31 (24.0%)		
		Inspected	135	182	38	129		

For *C. ovis* in sheep, the infection was only found in the heart (100%). *C. tenuicollis* in slaughtered sheep and goats was found in the omentum (62.92%) and (67.52%), followed by mesentry (12.36%) and (21.37%), liver (11.24 %) and (11.11%), respectively. While urinary bladder (9%), diaphragm (2.25%) and lung (2.25%) were recorded in sheep and not recorded in goats Table (3).

Table 3: The predilection seats of *Cysticercus tenuicollis* in different organs.

Animal species	Inspected		Liver		Lung		Urinary bladder		Diaphragm		Mesentery		Omentum		X ²	P-value
	Inspected	Infected	Infected	%	Infected	%	Infected	%	Infected	%	Infected	%	Infected	%		
Sheep	669	89	10	11.24	2	2.25	8	9	2	2.25	11	12.36	56	62.92	195	<0.0001
Goat	484	117	13	11.11	0	0	0	0	0	0	25	21.37	79	67.52	253	<0.0001

II. Gross and microscopic examination of metacestodes in slaughtered animals.



Figure 1: Heart of sheep showing whitish nodules of *Cysticercus ovis* (arrows) (X5, Bar =1 cm).

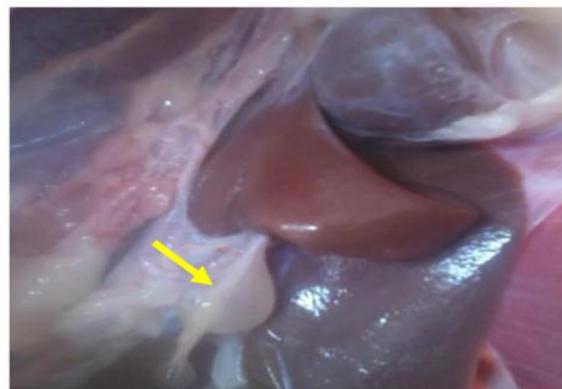


Figure (2): *Cysticercus tenuicollis* in goat attached to the liver (arrow) (X5). It appears as bladder like gross appearance showing large circular brown to red areas with alternate areas of hemorrhages also appeared on the liver surface and in the parenchyma due to migration of *C.tenuicollis*.

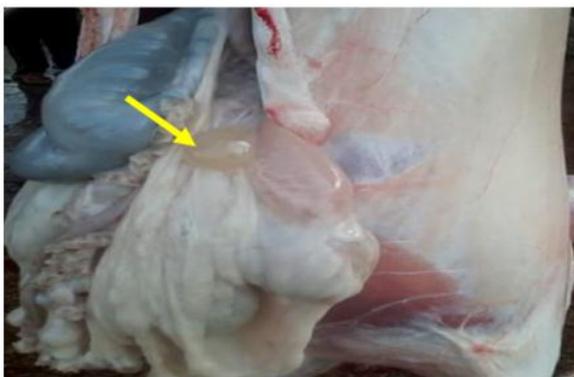


Figure (3): *Cysticercus tenuicollis* in goat attached to the omentum. (arrow) (X5). It was containing fluid and appears scolex inside it. Omentum gross lesions included accumulation of a large quantity of serofibrinous fluid in the peritoneal and thoracic cavities and a large number of small-sized cysts floating in the fluid of the peritoneal cavity.



Figure (4): *Cysticercus tenuicollis* in goat appears as bladder filled with viscous fluid and scolex appeared, followed by immature segments were inside a sticky yellowish sheath (X5, Bar = 4cm in diameter).

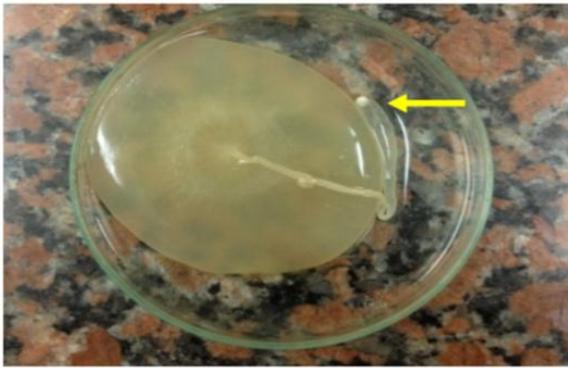


Figure (5): *Cysticercus tenuicollis* after removing its outer sheath in a petri-dish showing its longitudinal whitish scolex with its suckers (arrow), followed by segmentation attached to bladder like. It was motile in a wave like action (X5).

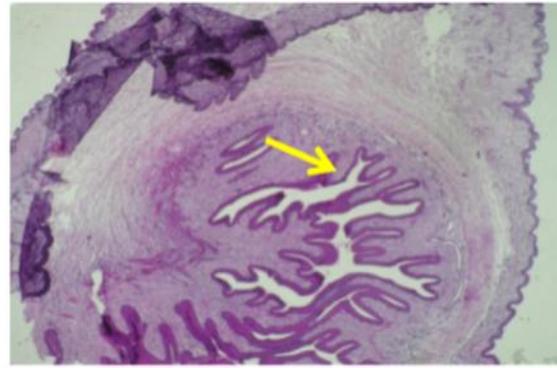


Figure (6): Cross section of *Cysticercus tenuicollis* stained with H&E stain (X40). Showing the cystic membrane of *C.tenuicollis* (arrow) surrounded by a zone of inflammatory cells and fibroblasts.

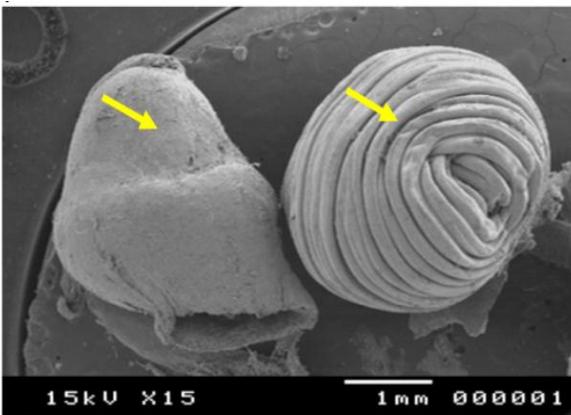


Figure (7): Scanning electron microscopy showing scolex of *Cysticercus tenuicollis* scolex which appears with circular striations in construction (Right arrow) and a cap tegument covered the scolex (Left arrow). (15KVx15, Scale 1µm).



Figure (8): Higher magnification with scanning electron microscope for *Cysticercus tenuicollis* scolex showing invaginated inverted scolex and its suckers hidden within the scolex. (15KVx35, Scale 500µm).

DISCUSSION

I. The infection rate of *Cysticercus ovis* in slaughtered sheep:

Out of 669 examined sheep in Aswan slaughterhouse, the occurrence of *Cysticercus ovis* was (1.94%). This result is in agreement with those reported by Hashemnia *et al.* (2016) (1.27%) in Iran. While this result is relatively higher than that previously reported by Ali (2013) (0.35%) in Qena, Egypt, Oryan *et al.* (2012) (0.09%) in Iran. However, this result is lower than those reported by Abdel-Maogood *et al.* (2005) (5.66%) in Cairo, in Egypt, White (1976) in western Australia, Sissay *et al.* (2008) in Ethiopia, Al-Qureishy (2008) in Saudi Arabia. In this study, *C.ovis* was not recorded in goats, while Sissay *et al.* (2008) in Ethiopia reported *C.ovis* infection in goats.

II. The infection rate of *Cysticercus ovis* in slaughtered sheep in relation to sex:

Females of slaughtered sheep (2.63%) were more susceptible to *C.ovis* infection than males (1.59%).

There was no statistical difference for ovine cysticercosis in regards to sex ($P>0.05$). On the other hand, Hashemnia *et al.* (2016) reported that the infection rate of *C.ovis* in slaughtered sheep was significantly higher in males than females ($P<0.05$).

III. The infection rate of *Cysticercus ovis* in slaughtered sheep in relation to age:

Older sheep, over two years old, were more susceptible for *Cysticercus ovis* (3.26%) than younger animals, less two years old, (1.18%). While there were no statistical significance of *C.ovis* in slaughtered sheep with regard to age ($P>0.05$).

IV. The infection rate of *Cysticercus ovis* in slaughtered sheep in relation to season:

In regards to seasonal variation of *Cysticercus ovis* in sheep, the highest infection rate was found in spring (4.1%), followed by winter (1.9%) and summer (0.5%). There was no statistical significance of *C.ovis* in regards to seasons ($P>0.05$). This result was agreed with Hashemnia *et al.* (2016). While Al-

Qureishy (2008) found that the highest infection rate (17.5%) was in autumn, followed by spring (14.3%), winter (9.7%) and the lowest was in summer (6.2%).

V. The infection rate of *Cysticercus ovis* in slaughtered sheep in relation to predilection seats:

The only predilection seats of *Cysticercus ovis* were in the heart of sheep (100%). This was agreed with Hashemnia *et al.* (2016), Gessese *et al.* (2015) in Ethiopia, Zheng (2016) in China.

VI. The infection rate of *Cysticercus tenuicollis* in slaughtered sheep and goats:

In this study, the overall infection rate of *C.tenuicollis* in 669 sheep and 484 goats slaughtered at Aswan slaughterhouse was (13.3%) and (24.2%), respectively. This result for slaughtered sheep and goats which infected with *C.tenuicollis*, respectively, was agreed with those reported by Omar *et al.* (2016) (16%) and (19%), in upper Egypt Governorates (Qena, Sohag and Aswan), Sultan *et al.* (2010), Abedl-Maogood *et al.* (2005), El-Dakhly (2007), Arafa and Fouad (2008) in Egypt, Radfar *et al.* (2005) in Iran and Scala *et al.* (2015) in Italy.

While it was higher than that reported by Mirzaei and Rezaei (2015) (4%) and (4.9%) in Iran, Bhaskararao *et al.* (2003), Singh *et al.* (2015) in India, Jayousi (2014) in Palestine. This result was lower than those reported by Abdulatif *et al.* (2015) (45%) and (53.9%), Sissay *et al.* (2008), Wondimu *et al.* (2011) in Ethiopia, Bui and Murtala (2012) in Sudan. While Braae *et al.* (2015) in Tanzania recorded wise infection rate of *C.tenuicollis* in sheep and goats (51.9%) and (45.7%), respectively.

The infection rate of *C.tenuicollis* was higher in goats as compared to sheep and this may be due to close contact between dogs and goats according to Torgerson *et al.* (1998). Also, this may be due to protective immunity, which early developed in life for most sheep which was under conditions of high infestation of *Cysticercus tenuicollis* and this immunity regulate the parasite population, whereas goat develops the immunity more slowly. On the contrary, Pathak and Gaur (1982), Akinboade and Ajiboye (1983), Bhaskararao *et al.* (2003) and Sissay *et al.* (2008), who found that the rate of infection was higher in sheep than in goats.

VIII. The infection rate of *Cysticercus tenuicollis* in slaughtered sheep and goats in relation to sex:

The infection rate of *C.tenuicollis* was higher in female sheep and goats (28.5%) and (46.7%) than male ones (5.4%) and (20.9%), respectively. There were very highly significant differences in infection rates with *C.tenuicollis* among slaughtered sheep ($P<0.000$) while among goats were not significant ($P>0.05$). This result agreed with Omar *et al.* (2016), Akinboade and Ajiboye (1983), Abu-Elwafa and Al-Araby (2008), Mirzaei and Rezaei (2015). On the

other report carried by Senlik (2008) who found that the highest infection rate was observed in male animals (26%) compared to females (23.9%). Moreover, Jayousi (2014) found that the sex wise infection rate was lower in females of sheep (2.7%) as compared to male ones (2.15%).

IX. The infection rate of *Cysticercus tenuicollis* in slaughtered sheep and goats in relation to age:

The infection rate of *C.tenuicollis* was higher adult sheep and goats (15.5%) and (25%) than in the young ones (12.03%) and (24.1%), respectively. There were no significant differences in infection rates among slaughtered sheep and goats in regard to age ($P>0.05$). This result agreed with Akinboade and Ajiboye (1983), Pathak and Gaur (1982), Bhaskararao *et al.* (2003), Abu-Elwafa and Al-Araby (2008), Senlik (2008), Abdulatif *et al.* (2015), Mirzaei and Rezaei (2015), Wondimu *et al.* (2011) and Omar *et al.* (2016). While Jayousi (2014) reported that the infection rate of *C.tenuicollis* was higher in young sheep (4.1%) than the older ones (1.9%). The highest infection rate in older animals than in younger ones might be due to decreased immunity in older animals than younger ones Bhaskararao *et al.* (2005). Moreover, may be due to close contact between older animals and dogs as mostly of young animals kept indoors than older animals.

X. The infection rate of *Cysticercus tenuicollis* in slaughtered sheep and goats in relation to season:

According to seasonal dynamics of *Cysticercus tenuicollis*, the infection rate in sheep and goats, respectively, was higher in autumn (21.6%) and (73.7%), followed by winter (12.4%) and (24%). *C.tenuicollis* infection with regard to season, there was very highly significant differences in goats ($P<0.0001$) while among sheep non-significant ($P>0.05$). This result was agreed with Abu Elwafa and Al-Araby (2008).

XI. The infection rate of *Cysticercus tenuicollis* in slaughtered sheep and goats in relation to predilection seats:

The infection rate of *C.tenuicollis* in different organs of sheep and goats showed that the most predilection seats of the cysts were in omentum (62.92%) and (67.52%), followed by mesentry (12.36%) and (21.37%), liver (11.24 %) and (11.11%), respectively. While urinary bladder (9%), lung and diaphragm with the same lowest percentage (2.25%) for each. The difference between the infection rate of omentum and other organs was very highly significantly associated ($P<0.0001$). This is in agreement with Gessese *et al.* (2015), Abu-Elwafa and Al-Araby (2008), Radfar *et al.* (2005), Wondimu *et al.* (2011), Bui and Murtala (2012), Omar *et al.* (2016), Abdulatif *et al.* (2015), Fahmi (2014). While Mirzaei and Rezaei (2015) found that the liver was the highest

infection rate for *C.tenuicollis* in slaughtered sheep and goats (1.64%) and (2%), respectively.

Cysticercus ovis appear as small whitish cysts filled with fluid that contain an immature worm this was agree with Omar *et al.* (2016).The cyst have the size of a grain rice (~4 to 9 mm). Infected meat can have dozens of such cysts. *Cysticercustenuicollis* in goat was contained fluid and appears scolex inside it. Omentum gross lesions included accumulation of a large quantity of serofibrinous fluid in the peritoneal and thoracic cavities and a large number of small-sized cysts floating in the fluid of the peritoneal cavity. *Cysticercustenuicollis* stained with H&E stain showing the cystic membrane of *C.tenuicollis* surrounded by a zone of inflammatory cells and fibroblasts. This agree with Abdulatif *et al.* (2015), show that the *C. tenuicollis* hemorrhagic streaks large concentric foci of hemorrhage in the hepatic parenchyma in the migration stage were observed. In histopathological examination, decreased number of hepatocytes, dilution of sinusoids presence of inflammatory cells in portal areas and double layered parasitic cyst formation in chronic stages were evident. Scanning electron microscopy showing scolex of *Cysticercus tenuicollis* scolex which appears with circular striations in construction and a cap tegument covered the scolex. The bladder wall consists of two main layers. Scanning electron microscopy showed that the outer surface of the bladder is a rough surface consisting of numerous sparsely situated microtriches with no apparent pattern of distribution. They are long and fine as a result of which they are intertwined, forming some thing like a network among which closed areas, lagoons, are formed this agree with Abu-Elwafa and Al-Araby (2008) The thin elongated microtriches are in most cases connected with another by transverse connections sheep measles (*Cysticercus ovis*) cause condemnation of carcasses or parts of carcasses at abattoirs, but they rarely cause ill-effects in the sheep or goats. Small white cysts appear in certain muscles, and while these cannot infect humans, they are considered unacceptable, leading to carcass condemnation. Any affected organs (e.g. hearts) are condemned and cysts are trimmed from muscle in light infections.

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داء الكيسات المذنبة في المجترات الصغيرة المذبوحة في مجزر أسوان بمحافظة أسوان

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تم دراسة وجود عدوى أطوار يرقات الديدان الشريطية بين الحيوانات المذبوحة من الأغنام والماعز وقد أجريت الدراسة في مجزر أسوان في محافظة أسوان بصعيد مصر وتم فحص عدد إجمالي ٦٦٩ من الأغنام بالإضافة الي ٤٨٤ من الماعز، وذلك خلال الفترة الممتدة من أغسطس ٢٠١٥ وحتى نهاية يوليو ٢٠١٦ م. وبفحص الحيوانات المذبوحة وجد نوعان من يرقات الديدان الشريطية وهي اليرقة المثنائية الغنمية واليرقات المثنائية ذات الرقبة المعلقة تم الكشف عن اليرقة المثنائية الغنمية في الأغنام وسجلت معدل إصابة (١.٩٤%) وكانت الاناث من الأغنام أكثر عرضة للإصابة باليرقة المثنائية الغنمية (٢.٦٣%) من الذكور (١.٥٩%) كما وجد أن الأغنام البالغة (الأكثر من سنتين) أكثر قابلية للإصابة (٣.٢٦%) من الأغنام الأصغر سنا (الأقل من سنتين) (١.١٨%). ولوحظ أن أعلى معدل انتشار موسمي لليرقات المثنائية الغنمية في فصل الربيع (٤.١%) ، ثم في فصل الشتاء (١.٩%) ، يليه فصل الصيف (٠.٥%). وقد وجد أن القلب هو العضو الوحيد المصاب باليرقات المثنائية الغنمية بين مختلف أعضاء الجسم (١٠٠%). بالنسبة لليرقات المثنائية ذات الرقبة المعلقة فقد سجلت (٢٣.٧%) و(١١.٩٨%) في الماعز والأغنام المذبوحة علي التوالي. وقد وجد أن اناث الماعز والأغنام أكثر عرضة للإصابة (٤٦.٧%) و (٢٨.٥%) من الذكور (٢٠.٩%) و(٥.٤%) علي التوالي. كانت الحيوانات البالغة من الأغنام والماعز (أكثر من سنتين) أكثر قابلية للإصابة (١٥.٥%) و (٢٥%) من الحيوانات الأصغر سنا (أقل من سنتين) (١٢.٠٣%) و(٢٤.١%) علي التوالي. وقد لوحظ أن أعلى معدل إصابة موسمي لليرقات المثنائية ذات الرقبة المعلقة في الماعز والأغنام المذبوحة وجدت في فصل الخريف (٢١.٦%) و (٧٣.٧%) ، يليه فصل الشتاء (١٢.٤%) و(٢٤%) ، ثم فصل الربيع (١١.٩٨%) و(٢٣.٧%) ، وأدني معدل انتشار في فصل الصيف (١١.٦%) و (٤.٣%) علي التوالي. تم ملاحظة وجود اليرقات المثنائية ذات الرقبة المعلقة في الأغنام والماعز المذبوحة في أعضاء الجسم المختلفة وكانت أكثر حدوثاً في الثرب عن أي عضو آخر حيث كان المعدل (٦٢.٩٢%) و (٦٧.٥٢%) ، يليه المساريق (١٢.٣٦%) و(٢١.٣٧%) ، ثم في الكبد (١١.٢%) و(١١.١١%) في الأغنام والماعز علي التوالي، ثم المئانة البولية (٩%) والحجاب الحاجز (٢.٢٥%) والرئة (٢.٢٥%) في الأغنام فقط. تم الفحص والتعرف علي اليرقات الشريطية في الحيوانات المذبوحة بالفحص العيني وكذلك التعرف علي التركيب الميكروسكوبي لكل منها سواء بالصبغات او بالميكروسكوب الالكتروني.