

## Prevalence of *Cysticercus Ovis* among Slaughtered Goats in Makkah, Saudi Arabia

Areej O. Bakhraibah and Muslimah N. Alsulami

Department of Biology, Faculty of Science, University of Jeddah, Saudi Arabia.

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**Cysticercus ovis** the intermediate stage of a canine tapeworm, *Taenia ovis*, produces cystic lesions in the skeletal and cardiac muscle of goats. This study was carried out to determine the prevalence of *cysticercus ovis* in goats collected from Al Kakee's Slaughter, Makkah, Saudi Arabia. A number of goats were collected for examination, a total of 51,750 locally raised goats and 61,911 imported goats. The experiment started at May 2017 and ended in April 2018. The results revealed that *cysticercus ovis* is common among imported goats more than local goats as implied in the tables attached below. As well as the evidence that the highest rate of infections was found during the warm months of summer.

**Keywords:** Goats, Slaughtered, *Cysticercus Ovis*, Prevalence, Infection, Veterinary Significance.

Cysticercosis, a parasitic infection caused by the larval form of the pork tapeworm. *Cysticercus Ovis*, also known as *Taenia Ovis*, is a parasite from the cestodes family that uses sheep, goats and cattle (livestock) as their intermediate host. Cysticercosis has a complex life cycle. The larval infection, cysticercosis, is transmitted through the fecal-oral route. Eggs from the adult tapeworm *T. solium*, which are directly infectious, are shed in the feces of a human tapeworm carrier and subsequently ingested by pigs, the usual intermediate host (Sorvillo *et al.*, 2007). The oncosphere embryos emerge from the eggs, penetrate the intestinal wall, and are disseminated by the bloodstream to various tissues where the larval stage, or cysticercus, develops. The cycle is completed when humans, the only naturally infected definitive host, consume raw or undercooked pork containing cysticerci, which attach to the small bowel and develop into the adult tapeworm. However, humans may also become infected with

the larval stage when eggs are ingested, typically in contaminated food or water. Neurocysticercosis, the most severe form of the disease, occurs when larvae invade tissue of the central nervous system. *Cysticercus ovis*, the intermediate stage of a canine tapeworm, *Taenia ovis*, produces cystic lesions in the skeletal and cardiac muscle of sheep which, if numerous, will result in the condemnation of an entire carcass (DeWolf *et al.*, 2012). *Cysticercus ovis* can be found in dogs (Jenkins *et al.*, 2018) known as *Echinococcus* and in pigs known as *Taenia Solium* and can be transferred to sheep and cattle (Garedaghi *et al.*, 2012), even deers (Al-Sabi *et al.*, 2013). When the meat of animals is infected with the *C. ovis* and consumed by humans it can cause cysticercosis disease or taeniasis when found in the small intestines (Neghab *et al.*, 2006; Neva and brown, 1994) and other organs of the human body. Thus, humans are considered the definitive host of the *cysticercus ovis* (Eckert & Deplazes, 2004). *C. ovis* is a thin walled cyst like structure that is filled

\*Corresponding author E-mail: m-n-solima@hotmail.com



with fluids, approximately 1 cm in diameter. The cyst in the muscle will degenerate over time and calcify, forming a small nodule known as sheep measles (DeWolf *et al.*, 2012).

The infection usually leads to a lower production rate and in some cases of heavy infection, the death of the animals hosting the parasites (Radfar *et al.*, 2005). Unfortunately, in some cases the condemnation of the entire carcasses is essential when the rate of contamination is high (Hashemnia *et al.*, 2016): (Thompson & Lymbery, 1995).

Preventing and curing the disease is an essential move that needs to be taken as soon as possible because parasites such as the *Cysticercus ovis* can be prevented or cut down by various methods (Anna Erickson, 2018). Although, most countries do not have enough data to implement disease control campaigns (Zheng, 2016). Condemnation of the meat causes a catastrophe in the meat industry especially when the rate of infection is high (Cabaret *et al.*, 2002). It is a major economical loss to the meat industry as well as a public health catastrophe (EARO, 2000).

## MATERIALS AND METHODS

### Field study area

This cross-sectional study was carried out in one of the biggest abattoir in Makkah province in west of Saudi Arabia, on the east coast of the Red Sea, the gateway to the Two Holy Mosques and the main port in the Kingdom (Fig 1).

The nature of its climate is cool in winter  $C^{\circ} 20$  hot in summer  $C^{\circ} 42$ . The abattoir was visited periodically to examine the slaughtered animals *Cysticercus Ovis* for the presence of goats.

### Animals number examination

A number of goats were collected for testing, a total of 51,750 locally raised goats and 61,911 imported goats. All tested goats were from Al Kakee's slaughter, Makkah, Saudi Arabia. The period of testing began in May 2017 to April 2018, therefore the experiment was conducted for one whole year.

51,750 local goats were slaughtered during the period of experiment from May 2017 to April 2018, along with a total 61,911 imported goats were slaughtered as well during the same period of experiment. Both groups of goat's meat

has gone through a visual inspection with the aid of a manual lens of the mesentery, peritoneal cavity, liver, lungs, kidneys, striated muscles, heart, femoral muscle, diaphragm muscle, tongue and the head of each carcass for the presence of the *Cysticercus ovis*.

### Data analysis

The data were analyzed using Chi-square analysis to compare the infection rate capacity between infected and non-infected goats. All statistical analyses were performed using SPSS software program (version 22). Probability of  $P < 0.05$  was regarded as significant at 95% confidence limit of significance between the two different groups of goats.

## RESULTS

Prevalence of the *Cysticercus ovis* was tested among local and imported goats. The relevance of the months gives us a chance to study when is the highest rate of infection.

In table (1), it is recorded the number of infected and slaughtered local goats. The highest rate of infection (3.89%) among local goats was studied in the month of August 2017. And the lowest rate of infection (0.25%) recorded among the local goats was during the month of October 2018.

In table (2), the records are of the number of imported goats that were slaughtered and infected. The highest rate of infection among the slaughtered imported goats (5.30%) was recorded during the month of August 2017. The lowest rate of infected imported goats (1.72%) was recorded during the month of April 2018.

As shown in Table (3), the results showed significantly different prevalence of infection percentages, with no correlation between seasonal prevalence and mean temperature. The highest prevalence of *Cysticercus ovis* infection in goats was recorded during summer with 3.28% prevalence, whilst it was lowest during spring with 1.79% prevalence.

## DISCUSSION

*Cysticercus Ovis* is a thin walled cyst that is filled with fluids and can be found in infected animals, causing their meat to be of threat

if consumed by humans. The cyst in the wild domestic canids will degenerate over time and form a small nodule with a “gritty” texture which DeWolf *et al.*, (2012) called sheep measles.

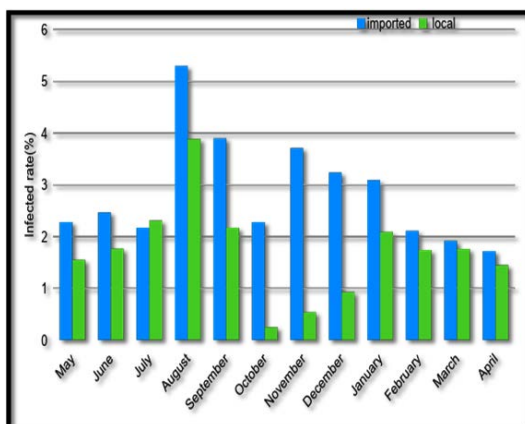
*Cysticercus Ovis* had infected 975 (1.88%) of locally raised goats in total throughout the year of the experiment. In imported goats, 1777 (2.87%) in total were found infected with the *cysticercus ovis*. Although the distribution of these cysts was found in different body parts and didn't seem to follow any patterns, Minozzo *et al.*, (2002) found the same result in his experiment.

The present investigation showed a high percentage of infection among slaughtered imported goats collected from Al kakee's slaughterhouse in

Makkah, Saudi Arabia. The highness percentage of infection was recorded to be 5.30% during the month of August in 2017. Our theory suggests that the results found were due to the fact that imported goats were suspected to be raised along with dogs or pigs, (unlike the local goats) as Smith & Sherman, 2009; Sharifiyazdi *et al.*, (2011) agreed. The *cysticercus ovis* infects dogs and wild canids (such as Wolves and jackals) and cattle such as goats, sheep and camels and humans as their final host as agreed by Eckert & Deplazes, (2004). Deer can also be one of the intermediate hosts as reported by (Al-Sabiet *et al.*, 2013). Supports our theory is the recent study by Jenkins *et al.*, (2018) in Australia where he found the presence of the *T. Ovis* parasite

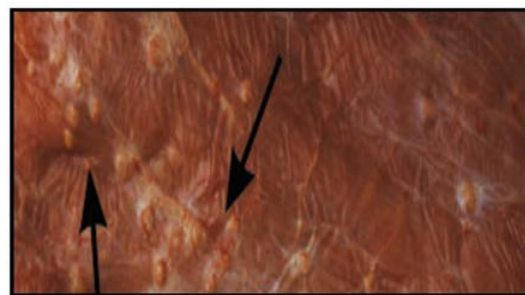


**Fig. 1.** Site of *cysticercus ovis* in goats collected from Al Kakee's Slaughter, Makkah, Saudi Arabia (by Google map)



**Fig. 2.** Comparison of infected rate between local and imported animals

among 374,580 slaughtered goats which is believed is due to the fact that these goats live in areas where foxes and dingoes are present.



**Fig. 3.** A demonstrative image of the *cysticercus ovis* in the meat of a slaughtered goats

The highest level of infection in local goats were found during the month of August 2017 with a percentage of 3.89%, with that we conclude that the imported goats were infected more than the local goats collected. An observation that was proved by the tables and charts attached is that the highest level of infection amongst the two groups of goats was found during the warm months of summer which agrees with the researches that Opara *et al.*, (2006) conducted on 25,800 cattle in Nigeria. This finding was also in agreement with

the results Oryan *et al.*, (1994) where he found the highest rate of infection was present in summer. Although, 11,228 cattle slaughtered in Ethiopia for an experiment conducted by Kebede *et al.*, (2008) was found infected with a percentage of 7.5% with no relevance to the months of infection and 2.3 % of infection in sheep by Al Qureishy (2008) and 20% in goats from western Ethiopia by Sissay *et al.*, (2008)

Our results all agreed with the results of Hashemnia *et al.*, (2016) where they inspected

**Table 1.** Number and infection rate of *cysticercus ovis* among slaughtered animals local

Year	Months	No. of slaughtered	No. of infected animals	Infection rate (%)*
2017	May	3336	52	1.55
	June	3896	69	1.77
	July	2857	66	2.31
	August	5673	221	3.89
	September	9294	202	2.17
	October	2757	7	0.25
	November	2752	15	0.54
	December	2901	27	0.93
2018	January	3435	72	2.09
	February	4060	71	1.74
	March	5325	94	1.76
	April	5414	79	1.45
Total	51750	975	1.88	

\*Infection rate= no of infected animals/ no. of slaughtered animals

**Table 2.** Number and infection rate of *cysticercus ovis* among slaughtered animals imported

Year	Months	No. of slaughtered	No. of infected animals	Infection rate (%)*
2017	May	5202	119	2.28
	June	4279	106	2.47
	July	3831	83	2.17
	August	6368	338	5.30
	September	8015	313	3.90
	October	3028	69	2.28
	November	3125	116	3.71
	December	3731	121	3.24
2018	January	4231	131	3.09
	February	5354	113	2.11
	March	7162	138	1.92
	April	7535	130	1.72
Total	61911	1777	2.87	

**Table 3.** Seasonal prevalence of cysticercus ovis infection in animals (\* referred to highest infection percent)

Infection rate (%)	No. of infected animals	No. of slaughtered	Season
3.28*	883	26904	Summer
2.44	722	29577	Autumn
2.25	535	23712	Winter
1.79	609	33974	Spring

69,198 sheep in Iran and found the highest percentage of infection to be in spring with a number of 1.8%.

The results are due to numerous factors such as the high temperature of the summer months along with the wide spread of contagious diseases due to the weakness of the immune system. The weakness of the goat's immune system makes widely spread parasites such as the cysticercus ovis easily contagious. Furthermore, easy access of animals to acquire infection with grass play is an important role in the epidemiology of this infection in the west of Iran as said by (Hashemnia *et al.*, 2015).

In addition, 3% of infection was found among 500 inspected cattle in Iran by (Garedaghi, *et al* 2012), these results agree with the results we found among the slaughtered goats in Saudi Arabia.

Thus, we are capable of having a comparison regarding the cysticercus ovis infection between the imported and local goats, as to both groups were found with the highest percentage of infection during the summer months unlike any other time of the year. Many factors play a role in the results conducted such as the immune systems being weak during the summer months or an infection being acquired from grass.

The rate of the cysticercus ovis infecting humans has definitely increased if we compare the results found by (Sorvillo *et al.*, 2007) (where 221 deaths were caused by cysticercosis over a 13 year study period) with the results found by Sainiet *al.*, (1997) (where he stated that the infection of the cysticercus ovis was "still rare in the united states").

The contamination of the cattle meat causes a major economical loss as commented EARO, (2000) and Thompson & Lymbery, (1995) respectively, as this problem reduces the export earnings of the country, especially in extreme cases

where the cattle die due to the disease as mentioned by Radfar *et al.*, (2005) or when the infection rate is high like the results that Cabaret *et al.*, (2002) found in Eastern Africa. Yet, countries such as china do not have enough data to implement disease control campaigns as researched by Zheng, (2016) regarding the Taenia ovis threatening the sheep of china. Although, some sites still hold a low rate of infection such as in western Canada as reported by (Lees *et al.*, 2002). Therefore, currently many of the information we have about the cysticercosis is based on researches in New Zealand, Australia, Canada and some African countries. (Lawson 1994; DeWolf *et al.*, 2012; Sissay *et al.*, 2008)

It is as well a health hazard and a public catastrophe due to the fact that the aberrant host of the cysticercus ovis is humans, this causes Taeniasis. Symptoms vary from abdominal discomfort to loss of weight and many more as reported by Neva and Brown, (1994) depending on the organ infected in a human by the C. ovis. Therefore, these results calls for a higher level of inspection of slaughtered meat and an urgent therapeutic as well as a preventing program for this arising crisis.

Techniques such as disposing the infected meat of the dead sheep on farm by burning or burial so that they cannot be scavenged is an effective way to cut down on the spread of the infection as advised by (Anna Erickson, 2018). Unfortunately, the condemnation of an entire carcass is essential if numerous sheep were found infected as declared by (Hashemnia *et al.*, 2016)

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