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# Study the prevalence of cysticercus tenuicollis in sheep and goats in Baghdad city

**Gharib Dohi Yaseen Al-Sudani**

Department of Parasitology, College of Veterinary Medicine, University of Baghdad, Iraq

\*Corresponding author email: [gharibdohi@gmail.com](mailto:gharibdohi@gmail.com)

**Prof. Amer Murhum Al-Amery**

Department of Parasitology, College of Veterinary Medicine, University of Baghdad, Iraq

**Abstract**--Cysticercus tenuicollis larval stage of dog's parasite Taenia hydatigena located in visceral organs of intermediate hosts (sheep and goats). In this study, the total of 100 sheep and 100 goats' visceral organs were inspected, C. tenuicollis was found in sheep was 21% (21/100); while the rate of infection was 35% in goats (35/100). According to the months of the study, the high rate in sheep was revealed in July, June, and August, 40% (4/10), 30% (3/10), and 25% (5/25) respectively; while the lowest rate was 10% (1/10) was recorded in January, March, April while in goats the lowest rate in March, February, and April was 20% (2/10), 30% (3/10), 30% (3/10) respectively, the rest of the months was 40% (4/10). In sheep, the highest infection rate with C. tenuicollis was 21.42% (18/84) in sheep males while the lowest rate was 18.75% (3/16) in sheep females while in goats the highest infection rate with C. tenuicollis was 35% (35/100) in males and lowest in female 0% (0). According to the age the infection rate of sheep less than 6 months ( $\leq 6$  m) was 10.5% (4/38) and  $>6 - \leq 12$  months was 25.4% (14/55) and more than 12 months ( $>12$ ) was 42.8% (3/7) however in goats the infection rate according to age in less than 6 months was 33.3% (14 /42) and  $>6 - \leq 12$  months was 36.3% (8/22) and more than 12 months ( $>12$ ) was 36.1% (13/36).

**Keywords**--tape worm, metacestoda, caprine, ovine, Iraq.

**Introduction**

*Taenia hydatigena* is a cosmopolitan intestinal parasite of domestic and wild canids (dog, wolf, fox, and coyote) that can infect much livestock, such as sheep,

buffalo, yak, cattle, and goats with its larval stage (*Cysticercus tenuicollis*) (27,28). It has been shown that the cysticerci of *T. hydatigena* can be deadly in kids and lambs' sheep because of serious hepatitis (30). Cysticercosis likewise fills in as an inclining factor for Black's disease and acute traumatic hepatitis (33). It does not prompt diminished ideal feed consumption obstructing legitimate development of contaminated creatures, and judgment of tainted cadavers (31). The disease has a cosmopolitan distribution with prevalence in the range of 0.1 and 32% varying between various countries and hosts (6). An epidemiological investigation on sheep tests in Sardinia, Italy demonstrated the all-out financial misfortunes identified with *T. hydatigena* cysticercosis added up to nearly €330,000 (28). The study aims to estimate the prevalence of *Cysticercus tenuicollis* in sheep and goats and study the effects of age groups sexes, and months of study in Baghdad city.

### Materials and Methods

A total of 200 (100 sheep and 100 goats) carcasses slaughtered in Al-shua'la abattoir in the northeast region of Baghdad governate at point (33°21'49.84" N 44°14'51.14" E according to GPS) will be examined for *C. tenuicollis* cysts during the period from the beginning of December 2020 to the end of August 2021. The organs will be inspected by applying the routine meat inspection procedures during postmortem examination paying attention to the visceral organs and abdominal tissues, thoracic and pelvic cavities to record the number and location of bladder cysts in both sheep and goats as shown in Figure (1) that cysts location on the omentum and liver (10).

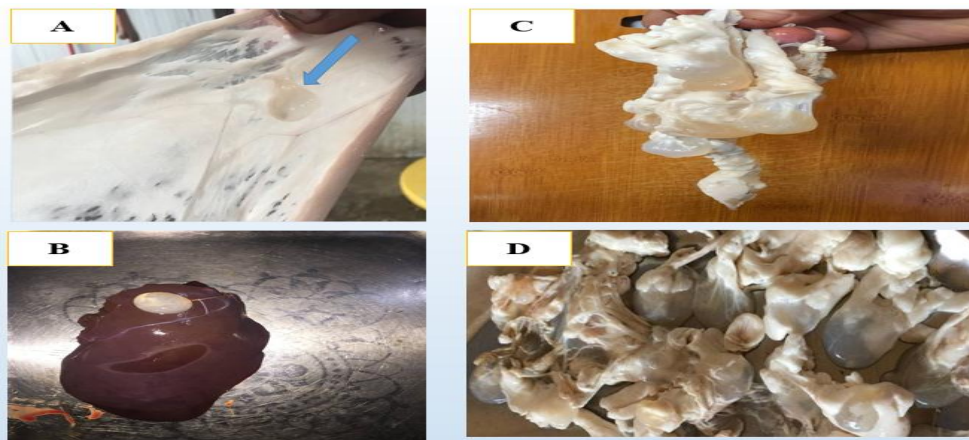


Figure 1. A; *Cysticercus tenuicollis* location on omentum, B; *C. tenuicollis* regains from the liver. C and D; bladder cyst varied in size.

### Statistical analysis

The Statistical Analysis System- SAS (2012) program was used to detect the effect of difference factors in study parameters. Chi-square test was used to significantly compare between percentage (0.05 and 0.01 probability). Estimate of Standard deviation, Range of parameters in this study.

## Results

The infection rates of sheep and goats with *Cysticercus tenuicollis* are summarized in table (1). prevalence of *C. tenuicollis* in sheep and goats according to a month of study as shown in table (2), and the effects of different sexes as shown in table (3), effects of age groups on the prevalence of *Cysticercus tenuicollis* in sheep and goats as shown in table (4).

## Discussion

The results of the study showed that the highest rate of infection recorded in goats (35%) and low rate 21% in sheep which agreed with the result of (13) 37.08% in goats and was 34.53% in sheep, and (4) who recorded 10% in goats and recorded 2% in sheep in Karbala, and Mosul Iraq respectively and with (26) who recorded 18.04% in goats and 12.87% in sheep in Iran, (23) in Egypt 19% in goats and 16% in sheep and (22) in India was 18.75% in goats and was 15.17% in sheep and (27) in Ethiopia was in goats and sheep 46.6 % – 40% respectively, (1) in Addis Ababa was 53% in goats and was 45% in sheep in Ethiopia also, (19) the prevalence higher in goats 51.7% than sheep 27.3%.

But it does not agree with (3) was recorded 40.55% in sheep and 26.25% in goats, (14) with 2.63% in sheep and 2.59% in goats, in Basrah and Sulaimani respectively Iraq, and (24) in Kerman province in Iran was 28.04 % in sheep and was 18.04 % in goats and (32) in Ethiopia was 79% and 53% in sheep and goats respectively. The prevalence of infection was dependent on management methods of different livestock and numbers of infected dogs in contact with farm animals, the differences in feeding management and grazing behavior of goats because most the farmers prefer outdoor feeding for goats that stray dogs enclosed with animal population and near slaughter opening places and overpopulation and migration of stray dogs consider as the final host that spread huge assembly of parasite eggs in opening fields and contamination soil of pastures and that was reversed in Sheep feeding management that most of them indoor feeding management artificial ration that low chance to get an infection that made the rate of infection in goats higher than Sheep.

Table 1  
Rate of infection with *C. tenuicollis* in Sheep and Goats

Host	No. of examined	No. of infected	Prevalence (%)	Chi-Square ( $\chi^2$ )	** (P $\leq$ 0.01).
Sheep	100	21	21	9.702 **	
Goats	100	35	35	8.417 **	

### Monthly examination of slaughtered sheep and goats for detection of *C. tenuicollis*

According to the months of study, the high rate in sheep was revealed in June, July, and August, 3 (30%), 4 (40%), and 5 (25%) respectively; and the lowest rate 1 (10%) was recorded in January, March, April while in the goats the lowest rate

in March, February, and April 2 (20%), 3 (30%), 3 (30%) respectively, the rest of the months was 4 (40%), Statistical analysis of the data showed significant ( $p \leq 0.05$ ) differences in the rate of infection between these months Table, (2). The results agreed with Haddawee (13) in Iraq who mentioned that the highest rate of goat infection was higher in August, 45.57%, and Gracey *et al.*, (12) in the UK who showed the differences in rate between April and July, 11% and 4% respectively. El-Azazy and Fayek (9) in Egypt recorded heaviest rate sheep and goat's infection were same in August 6.4% but it different with Ghaffar (11) in Duhok / Iraq who mentioned heaviest incidence was observed in February (1.4%), and the lowest was the same in Jun and July (0.3%) and Mohammed and Kadir (20) Sulaymaniyah province Iraq was recorded in sheep the highest rate of infection in April (26.1%) and lower rates in August 19.0%.

Also, Khanjari *et al.*, (18) The lowest rate of infection was observed in sheep and goats in winter (December, January, and February) were 0.58% and 0.50% respectively, and the highest levels were in spring (March, April, and May) 1.75%, 1.50% respectively. Additionally, Khaled *et al.*, (17) in North East Tunisia the heaviest incidence was observed in February and March (5%, 5.3%) respectively and the lowest was in January (0.8%) in sheep while in goats the high rate in February and March was 4.5%, 18.2% respectively, and lower rate in January was 0%. The variation between studies in the rate of infection during seasons (months) could be because of the variety in ecological conditions (temperature, humid and winds) the level of pasture field contamination due to uncontrolled canids (rural dogs, and stray dogs) movements, and the method of raising and feeding management of sheep and goats that might devote to the transmission cycle between these animals, and stray dogs. The pasturing and feeding management can be considered as the large-scale reason behind these differences. Uncontrolled stray dogs on brushing land and open green fields just as in the enclosures and infected dogs near feed storages, assist to increase the rates of infection in these animals.

The results of high rate in sheep were confirmed in June, and August, (40%) and (25%) respectively; while the lowest rate (10%) was revealed in January, March, April while in the goats the lowest rate in March and April (20%), (30%), that might increase in migration and movement of dogs from region to another across open unfences paddocks in worm months and contamination of pasture with dogs feces contain segments filled with a large number *T. hydatigena* eggs that provided suitable condition in green grass ( environmental conditions) that sources for ruminant feeding. another hand decreases in movement in cold months lead to a decrease in pollution of pastures with eggs of parasites.

Table 2  
Distribution of *Cysticercus tenuicollis* according to months of study

No.	Month	Host						
		Sheep			Goats			
		No. of examined	No. of infected	(%)	No. of examined	No. of infected	(%)	Chi-Square ( $\chi^2$ )
1	Dec.	10	2	20	10	4	40	7.84 **

	2020							
2	January	10	1	10	10	4	40	9.67 **
3	February	10	2	20	10	3	30	3.88 NS
4	March	10	1	10	10	2	20	3.79 NS
5	April	10	1	10	10	3	30	3.88 NS
6	May	10	2	20	10	4	40	7.84 **
7	June	10	3	30	10	3	30	1.00 NS
8	July	10	4	40	10	4	40	1.00 NS
9	August	20	5	25	20	8	40	5.39 *
Total		100	21	21	100	35	35	
Chi-Square ( $\chi^2$ )		---	---	9.688 **	---	---	8.417 **	---
* (P≤0.05), ** (P≤0.01).								

\* (P≤0.05) = statistically significant. \*\* (P≤0.01). = statistically highly significant.  
NS. = Non-significantly different.

### **The rate of infection with *C. tenuicollis* in sheep and goats according to sex**

Total of 100 samples collected from sheep the highest infection rate with *C. tenuicollis* was 21.42% (18/84) in males while the lowest rate was 18.75% (3/16) in females with significant (P≤0.01) differences while in goats the highest infection rate with *C. tenuicollis* was 35% (35/100) in males and lowest in female 0 (0%) At the degree of freedom 0.05 Table (3), that show results was agreed with Ibrahim and AlAmery (15), in Baghdad / Iraq higher prevalence was observed in sheep males 18.75% compared to females 16.66% and also with Al-Azawi and Al-Biatee (2) infection rate in males (~13%) and females (~17%), Mokhtaria (21) in North Algeria in male sheep 6.8% and female sheep 0.96% and in male goats 13.1% and female goats 9.19% and Jayousi (16) in Palestine that the male and female of sheep between 2.7%, 1.2% respectively. In Brazil De Morais *et al.*, (8) was noted that the male and female of goats 41.2%,36.7% respectively. On the other hand, it has disagreed with Al-Azizz and Essa (3) in Basrah observed the male and female of sheep and goats were 22.1% - 61.17 and 21.56% - 25.64%, respectively, and with Miran (19) that male 19.5% and female 24.5% of sheep and goats in Tanzania, Hama (14), in Sulaimani male sheep 2.24% and female sheep 2.65% while male and female of goats was 2.33%, 2.63% respectively.

In Karbala / Iraq the rate of infection in male and female of sheep and goats was ranged between 29.16% to 38.09% and 20% to 40.65% respectively (13), and (18) in Mazandaran province in Iran that females 8.29% and males 0.64%, also Alvi, *et al.*, (6) was recorded in sheep and goats of Pakistan the rate of infection in females 4.68% higher than in males 2.80%. It was obvious that goat infection rates in a normal host reflected by higher rate as compared to sheep and absence of female goats, these highest infection rates with *C. tenuicollis* was in males and females of sheep and goats 21.42%, 18.75% and 35%, 0% respectively. These differences in results according to the sex of animals due to variation in physiological and commercial variation that most of the males were selected for

fattening and females for breeding because the number of carcasses for sheep males and goats' kids' males was more than for females of both animals. As mentioned earlier stray dogs as the final host had a wide range of movement and access to the slaughterhouse and gets an infection from eaten offal of carcasses and contamination of pastures that made ruminant get infection for both sexes were grazing on same pastures and forages that could be polluted with infected feces of dogs.

That agreed with many researchers like Pathak, and Gaur (25), who mentioned that male dogs favor roaming more than females exclusively in the spring and autumn, which made physiological changes in bitches that many of them in heat at that time, that reason could be significant for the dissemination of eggs parasites. Most of the males were fattened selection their feed from artificial ration under special indoor management of animals and proportionate of the possibility of infection lower than outdoor animal management that reared on open pasture that accompanied with huge uncontrolled stray dogs or rural dogs in rural areas.

Table 3  
Distribution of *Cysticercus tenuicollis* in sheep and goats according to Sex

Sex	Host						Chi-Square (x <sup>2</sup> )
	Sheep			Goats			
	No. of examined	No. of infected	%	No. of examined	No. of infected	%	
Male	84	18	21.42	100	35	35	4.971 *
Female	16	3	18.75	0	0	0	6.744 **
Total	100	21	21	100	35	35	---
Chi-Square (x <sup>2</sup> )	---	---	1.376 NS	---	---	10.064 **	---

\* (P≤0.05), \*\* (P≤0.01).

\* (P≤0.05) = statistically significant. \*\* (P≤0.01). = statistically highly significant.  
NS. = Non-significantly different.

#### Rate of infection with *C. tenuicollis* in sheep and goats according to age groups

The infection rate according to the age of sheep less than 6 months ( $\leq 6$  m) was 10.5% (4/38) and  $>6 - \leq 12$  months was 25.4% (14/55) and more than 12 months ( $>12$ ) was 42.8% (3/7) with a significant (P<0.05) difference however in goats the infection rate according to age in less than 6 months was 33.3% (14 /42) and  $>6 - \leq 12$  months was 36.3% (8/22) and more than 12 months ( $>12$ ) was 36.1% (13/36) with a significant (P≤0.05) differences Table 4. These results were agreed of sheep and goats with Haddawee (13) in Karbala / Iraq the proportion of sheep and goats was less than one year 24.86% - 41.64%, 27.20% - 41.95%, while the adult sheep and goats of more than one year were 26.11% -43.64 %, 21.42% - 50%, respectively, (11) Duhok / Iraq who mentioned the highest infection rate

was found in sheep older than 2 years (1.7%), while the lowest was in sheep younger than one year (0.1%), and Samuel and Zewde (27) in the center of Ethiopia in adult goats (51.8%) and sheep (47.4%) were more infected than kids (41.4%) and lambs 35.8% respectively. Abdulatif *et al.*, (1) in Ethiopia, recorded the rate of infection in adult goats 59.9%, and sheep 54.3% were higher infected than young goats 46.3% and young sheep 34.7%. Also, Bejiga (7) in Ethiopia infection rate was found in young sheep 28.3% than in adult sheep 46%. and with Wondimu (35) in Ethiopia that Adult goats 68.8% and sheep 61.5% were more infested than kids 59.03% and lambs 52.1%, respectively but it different in sheep with, Ibrahim and AlAmery (15) in Baghdad / Iraq, were in young sheep 18.75 % and adult 5.42% and Al-Maialy (5) in Diwaniya / Iraq, were in young 19.6%and adult sheep 0%- 3.2 and sheep and goats with Saulawa *et al.*, (29) in Sokoto, Nigeria, was shown that prevalence of infection increased with the age of the animals < 12, 12 – 24 and > 24 was 10.17%, 11.18 and 24.39 respectively and Khanjari *et al.*, (18) in Mazandaran province in Iran noted that the age of sheep and goats under 12 months and 12 months and over was 0.49%,4.81%, and 0.54%, 5.02% respectively. The variation in the results may be due to the number of samples that examined the age of sheep and goats between less than 7 months and 8–11 months is greater than that of more than 12 months because the number of carcasses for sheep lamb and goats' kids is more than for adults of both animals. However, lambs and kids were more infected than adults, depending on the number of eggs of *T. hydatigena* swallowed and the immune system weaker and less developed, which makes them more numerous of various pathogens, including parasites, (29), and the cysticerci of *T. hydatigena* could be fatal in lambs because of severe hepatitis (30), and another important reason was the overpopulation of stray and rural dogs that were accompanied by the grazing of ruminants in the pastures. These dogs play a significant role in the widespread transmission of the parasite through its ingestion of the waste of infected animals, and through it was excreted from feces containing parasite eggs on pastures.

Table 4  
Distribution of *Cysticercus tenuicollis* according to age groups

Age groups Months	Host						Chi-Square (x <sup>2</sup> )
	Sheep			Goats			
	No. of examined	No. of infected	(%)	No. of examined	No. of infected	(%)	
≤ 6	38	4	10.5	42	14	33.3	7.83 **
>6 - ≤ 12	55	14	25.4	22	8	36.3	4.39 *
>12	7	3	42.8	36	13	36.1	1.63 NS
Total	100	21	21	100	35	35	5.29 *
Chi-Square (x <sup>2</sup> )	---	---	11.48 **	---	---	1.076 NS	---

\* (P<0.05) = statistically significant. \*\* (P<0.01). = statistically highly significant. NS= Non-significantly different.

## References

1. Abdulatif, A., A.K. Tsegay, and B. Mammo. 2015. Prevalence, cyst distribution in visceral organs, and economic loss of *Cysticercus tenuicollis* in small ruminants slaughtered at Bishoftu, Elfora Export Abattoir. Am. Eur. J. Sci. Res. 10, 210–220
2. Al-Azawi, A. Kh. A. and S.T. Al-Biatee. 2019. Prevalence and phylogeny of *Cysticercus tenuicollis* sp. determined by PCR from 6909 slaughtered sheep over 12 months. Online Journal of Veterinary Research©.Volume 23 (6):594-605, 2019
3. Al-Azizz S. A. and I. M. Essa. 2011. "Studies on *Cysticercus tenuicollis* collected from slaughtered sheep and goats in Basrah abattoir, Iraq," Egyptian Journal of Experimental, Biology (Zool.),7(2):343 – 347,2011
4. Al-bakri, H. S. 2012. Prevalence of Tenuicollosis Among Livestock Slaughtered at Ninevah Governorate-Iraq. Journal of Advanced Biomedical & Pathobiology Research 2(1): 30-39.
5. Al-Maialy, H. M. 2005. The incidence and pathology of cysticercosis in sheep naturally infected with *Cysticercus tenuicollis* larvae. University of Al-Qadisiya
6. Alvi, M.A., J.A. Ohiolei, M. Saqib, L. Li, N. Muhammad, M.H. Tayyab, W. Qamar, A.A. Alvie, Y.D. Wu, X.R. Li, B.-Q. Fu, H.B. Yan, and W.Z. Jia. 2020. Preliminary information on the prevalence and molecular description of *Taenia hydatigena* isolates in Pakistan based on mitochondrial cox1 gene. 1567-1348/ 2020 Elsevier.
7. Bejiga T., A. Haile, T. Solomon, D. Sefir and M. Pal. 2016. "Prevalence of *Cysticercus tenuicollis* in Small Ruminants Slaughtered at Addis Ababa Abattoir, Ethiopia". World Vet. J. 2016, 6(3):137-142.
8. de Moraes D.F., V.L.R. Vilela, T.F. Feitosa, V.M. dos Santos, V.R. Gouveia, A. C. R. Athayde, and S.S. Sérgio Santos de Azevêdo. 2017. Prevalence and risk factors for *Cysticercus tenuicollis* in goats and sheep in Paraíba, northeastern Brazil. Braz. J. Vet. Parasitol., Jaboticabal, v. 26, n. 2, p. 235-238, Apr. - June 2017.
9. EL-Azazy O.M. and S.A. Fayek. 1990. "Seasonal pattern of *Fasciola gigantica* and *Cysticercus tenuicollis* infections in sheep and goats in Egypt". Bulletin of Animal health and Production in Africa. 1990, 38(4): 369-373.
10. Gasser, R. B., X. Zhu, and D. P. McManus. 1999. NADH dehydrogenase subunit 1 and cytochrome c oxidase subunit I sequences compared for members of the genus *Taenia* (Cestoda). Int. J. for Parasitology, 29, 1965-1970.
11. Ghaffar, N.M. 2011. Tenuicollosis in slaughtered sheep at Duhok abattoir – Kurdistan region of Iraq. Basrah J. Vet. Res. 10(1): 1-15.
12. Gracey, J. F, D. S. Collins, and R.J. Huey. 1999. Meat hygiene.10th ed Harcourt Brace and Copany.London.pp.665-666.
13. Haddawee R. H., I. M. Sulbi and Z.F. Abass. 2018. Prevalence of *Cysticercus tenuicollis* in slaughtered sheep and goats by season, sex, age, at Karbala abattoir, Iraq Sci. J. Med. Res., Vol. 2, Issue 5, pp 52- 56, Winter 2018.
14. Hama, A. A., R. H. Zorab, F. M. Ali, Salih, A. M. and A. A. Hassan. 2018. Prevalence and Molecular Characterization of *Cysticercus tenuicollis* Isolated from Some Intermediate Host in Kurdistan-Iraq. Kurdistan Journal of Applied Research, 177-182).

15. Ibrahim, S.I. and A.M. Al-Amery 2018. Study the Prevalence of *Cysticercus tenuicollis* in Sheep, and Experimental Infection of Dogs with Treated Metacestodes by Ethanolic Ginger Extract in Baghdad City. M.Sc. Thesis. College of Veterinary, Medicine University of Baghdad.
16. Jayousi A.A.Y. 2014. Prevalence and Molecular Characterization of *Cysticercus tenuicollis* Cysts in Sheep Slaughtered in Palestine. SC. Thesis. An-Najah university.pp.77.
17. Khaled, K., G. Teber, F. Bouaicha, S. Amairia, M. Rekik, and M. Gharbi. (2019). Infestation of small ruminants by the metacestode stage of *Taenia hydatigena* in slaughterhouse, North East Tunisia. Veterinary Medicine and Science. doi:10.1002/vms3.222.
18. Khanjari, A., N. Cheraghi, S. Bokaie, S. Fallah, A.A. Basti, M. Fallah, and F. Mohammadkhan. 2013. "Prevalence of *Cysticercus tenuicollis* in slaughtered sheep and goats by season, sex, age, and infected organ at Amol abattoir, Mazandaran province, Iran". Comp Clin Pathol. 2015, 24(1): 149-152.
19. Miran, M., A. Kasuku, and E. Swai. 2017. Prevalence of Echinococcosis and *Taenia hydatigena* cysticercosis in slaughtered small ruminants at the livestock-wildlife interface areas of Ngorongoro, Tanzania. Vet World, 10(4):411.
20. Mohammed, A. and M. Kadir. 2019. "Frequency of *Taenia hydatigena* cysts in slaughtered sheep in Sulaymaniyah province/Iraq." Revue De Medecine Veterinaire 170(7-9): 144-148.
21. Mokhtaria, K. S. Fadela, S.S.M. Ammar, B.T. Belcacem, A.A. Ammar, A.S. Ameer, and B. Abdelkader. 2018. *Cysticercus tenuicollis* in small ruminants of Algeria: abattoir survey, biochemical and morphological characterizations. Bulg. J. Agric. Sci. 24.
22. Nimbalkar, R.K., S. Shinde, V.N. Kamtikar, and S.P. Muley. 2011. Study on *Taenia hydatigena* in the slaughtered sheep (*ovis bharat*) and goats (*capra hircus*) in Maharashtra, India. Global Veterinaria 6(4):374-377.
23. Omar, M.A.E., L.O. Elmajdoub, M.S. Al-Aboody, A.M. Elsify, A.O. Elkhtam, and A.A. Hussien. 2016. Molecular characterization of *Cysticercus tenuicollis* of slaughtered livestock in upper Egypt governorates. Asian Pac. J. Trop. Biomed. 6, 706-708.
24. Oryan, A., S. Goorgipour, M. Moazeni, and S. Shirian. 2012. Abattoir prevalence, organ distribution, public health and economic importance of major metacestodes in sheep, goats and cattle in Fars, southern Iran. Trop Biomed 2012, 29(3): 349-359. PMID:23018497.
25. Pathak, K. M. L. and S. N. S. Gaur. 1982. The incidence of adult and larval stage *Taenia hydatigena* in Uttar Pradesh (India). Veterinary Parasitology, 10(1), 91-95.
26. Radfar, M.H. S. Tajalli, and M. Jalalzadeh. 2005. Prevalence and morphological characterization of *Cysticercus tenuicollis* (*Taenia hydatigena* cysticerci) from sheep and goats in Iran. Veterinarski arhiv 75; 469-476.
27. Samuel, W. and G. G. Zewde, 2010. Prevalence, risk factors, and distribution of *Cysticercus tenuicollis* in visceral organs of slaughtered sheep and goats in central Ethiopia. Tropical Animal Health and Production, 42; 1049-1051.
28. Sarvi S., B.L. Ebrahimi, A. Alizadeh, S. Abdollah Hosseini, S. Gohardieh, R. Bastani, J.Yazdani Charati, A. Daryani, A. Amouei, A. Spotin, and S. Gholami. 2020. Morphometric, genetic diversity and phylogenetic analysis of

- Taenia hydatigena* (Pallas, 1766) larval stage in Iranian livestock. Parasitol. Feb;147(2):231-239. Epub 2019 Oct 15. PMID: 31603069.
29. Saulawa M., A. Magaji, O. Faleke, A. Mohammed, A. Kudi, A. Musawa, A. Sada, A. Ugboma, B. Akawu and Sidi S. 2011. "Prevalence of *Cysticercus tenuicollis* cysts in sheep slaughtered at Sokoto abattoir, Sokoto state, Nigeria". Sokoto Journal of Veterinary Sciences. 2011, 9(2): 24–27.
  30. Scala, A., A.P. Pipia, F. Dore, G. Sanna, C. Tamponi, R. Marrosu, E. Bandino, C. Carmona, B. Boufana, and A. Varcasia. 2015. A. Epidemiological updates and economic losses due to *Taenia hydatigena* in sheep from Sardinia, Italy. Parasitology Research, 114,3137-3143.
  31. Singh, B.B.; R. Sharma, J.P.S. Gill, and J.K. Sharma. 2015. Prevalence and morphological characterisation of *Cysticercus tenuicollis* (*Taenia hydatigena* cysts) in sheep and goat from north India. J. Parasit. Dis. 39; 80–84.
  32. Sissay, M.M., A. Uggla, and P.J. Waller. 2008. Prevalence and seasonal incidence of larval and adult cestode infections of sheep and goats in eastern Ethiopia. Trop. Anim. Health Prod. 40; 387–394.
  33. Soulsby, E.J. 1982. Helminthes, Arthropods and Protozoa of Domesticated Animals. 7th ed. Baillière Tindall, London: 806-830.
  34. Taylor, M. A., R.L. Coop, R. L. Wall. 2007. Veterinary Parasitology. 4rd. Edition. Blackwell Publishing. Ltd: 210-211.
  35. Wondimu, A., D. Abera, and Y. Hailu. 2011. A study on the prevalence, distribution and economic importance of *Cysticercus tenuicollis* in visceral organs of small ruminants slaughtered at an abattoir in Ethiopia. J Vet Med Animal Health. 2011, 3:67–74.