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Bovine Hydatidosis: Prevalence and Economic Implication in Torra Municipality Abattoir, Central Ethiopia Region

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Abstract:

Objective: This study aimed to determine the prevalence of hydatid cysts and assess their direct economic impact.

Methods: The study utilized a cross-sectional design to examine cattle slaughtered in the Torra Municipal Abattoir, in which 384 bovine species were systematically selected.

Results: Out of the 384 slaughtered animals, 66 were found to have bovine hydatid cysts. A total of 112 cysts were collected, 44 (39.29%) of which were viable and 68 (60.71%) calcified. All examined organs showed hydatid cysts, but livers and lungs were most commonly affected, while tongues had the least amount. In terms of viable cysts, lung and liver contained the highest proportions, followed by heart and tongue. Consequently, the lung was the organ that was often impacted and had the greatest number of cysts. It was calculated that US$ 2,909 was lost annually as a direct economic loss. The animal's origin and sex did not significantly affect the infection rate statistically ($p > 0.05$). Similarly, there was no significant difference with age ($p > 0.05$).

Conclusions: The study revealed a notable prevalence and economic impact of bovine hydatidosis in the study area. Therefore, it is crucial to implement effective control and preventive measures to mitigate the impact of disease's impact on public health.

Keywords: *Abattoir; Bovine; Hydatid cyst; Prevalence; Torra.*

1 Introduction

Echinococcosis, a parasitic disease, significantly impacts the health and productivity of livestock. This condition, also known as hydatidosis, involves the infection of both animals and humans by adult tapeworms or their larva/metacestode stage of the echinococcus species (Harder and Mehlhorn, 2014). It poses a significant public health risk, with the condemnation of body parts, particularly the liver and lungs, leading to substantial declines in health and productivity. The adult tapeworm species *Echinococcus granulosus* lives in the small intestines of dogs, wolves, and coyotes, while the larva, or hydatid cyst, resides in the liver, lungs, and other organs of cattle, sheep, swine, horses, camels, wild ruminants, and humans (Pourseif *et al*., 2018; Hogea *et al*., 2024).

Echinococcus granulosus has a wide geographical spread, being found globally and affecting various climates and host species, from dogs and sheep to swine (Udainiya *et al*., 2024). It is particularly prevalent in cattle, sheep, camels, goats, and donkeys across much of Eastern Europe. Similar to the Middle East, the disease is also common in North Africa. Infection has been reported in many African countries south of the Sahara, including Ethiopia (Taghipour *et al*., 2021).

The life cycle of Echinococcus species is complex, involving two hosts and various stages, with transmission dynamics influenced by environmental factors. Environmental conditions and the behavior of hosts play a crucial role in the transmission of the parasite. After being excreted by the definitive host, the proglottids may remain active for a few days under suitable conditions. The eggs are dispersed rapidly, with radial dispersal and not affected by prevailing winds. Animals such as birds, flies, beetles, ants, earthworms, and flooding water are likely to play a role in this dispersal. The number of infective organisms entering the host is determined by the density, infectivity, availability of eggs in the environment, and the feeding behavior of the intermediate host (Thompson, 2017).

There are two main types of life cycles: the pastoral cycle, which involves domestic animals like dogs as definitive hosts and sheep, cattle, goats, camel, horses, and pigs as intermediate hosts, and the sylvatic cycle, which involves wildlife like wolves as definitive hosts and mice as intermediate hosts (Fu *et al*., 2021). The sylvatic cycle can also infect humans through domestic animals. In the pastoral cycle, adult tapeworms typically release proglottids or eggs in their feces. These eggs hatch in the colon of the intermediate host when consumed, allowing the tapeworm to enter the host's body. The tapeworm then attaches to the intestinal wall, enters the portal vein, and reaches the liver, where it acts as a filter. The remaining part of the tapeworm, along with the hydatid cyst, can then spread to other organs in the host. The life cycle is completed when a dog ingests an organ containing a hydatid cyst, which contains the protoscolex (Urquhart *et al*., 1996; Peralta *et al*., 2023).

While adult tapeworms often lead to enteritis in dogs, they seldom cause serious harm. The risk of harm from these cysts depends on how severe the infection is and which organ they're in (Kulesh *et al*., 2022). Most cases are only noticed at slaughterhouses, and in cows, a cyst in the liver or lungs usually goes away without showing any symptoms. Symptoms of the disease usually appear in organs like the kidneys, pancreas, central nervous system, or bone marrow (Habtie, 2019).

The significance of Echinococcus can be seen from both the economic impact on livestock production and the public health risks it poses (Fesseha and Assefa, 2022). The young stage of the cestode parasite leads to cystic hydatid disease, which affects both humans and various livestock species (Christofi, 2022). Humans can become infected with cystic hydatid disease by ingesting the eggs of Echinococcus tapeworms. This can happen through contact with pet fur that has been contaminated with these eggs, or by a dog passing the eggs in its feces and then ingesting them while licking humans ((Little, 2024). Livestock hydatidosis causes significant financial losses due to the prohibition of edible offal, especially the liver and lungs. It can also lead to indirect financial losses from medical and surgical costs, hospitalization expenses, drug treatments, and recovery time, loss of income and productivity due to work absences, and death from anaphylactic shock from cysts or leakage (Odero, 2015).

Ethiopia has great potential for livestock production, which is a key economic activity that generates income from both food and non-food products like manure, hides, and skins, as well as food items like milk and meat. Livestock also play a crucial role in risk reduction for crop failure. Despite this potential, the livestock sector is not fully utilized due to various challenges such as drought, malnutrition, and traditional livestock diseases (Sissay, 2007; Mazengia *et al*., 2017).

The lack of proper meat inspection, low public awareness, and the presence of large stray dog populations are believed to significantly contribute to the high prevalence of the disease in Ethiopia (52%) (Guduro and Desta, 2019). The estimated annual financial loss from this disease was around 58,114.62 USD. This study aimed to determine the prevalence and economic impact of hydatidosis in cattle at the abattoir in Torra Municipality, Central Ethiopia Region, underscoring the need for further research and interventions to address its effects.

2 Materials and Methods

2.1 Study Areas

The research took place in Torra Municipality Abattoir, located in Lanfro woreda, within the Silte zone of the Central Ethiopia Regional State. The weather conditions in this area are characterized by a mix of woinadega (midland) (77%) and dega (highland) (23%). The yearly average temperature here is 210 degrees Fahrenheit, and the annual rainfall averages at 1,012 millimeters. The altitude of the area ranges from 1,921 to 2,460 meters above sea level. The woreda is home to a diverse livestock population, including 47, 962 bovines, 30,556 ovines, 30,484 caprines, and 5,724 equines (LWAO, 2023).

2.2 Study population

The subjects of the study were local breed cattle of both sexes originating from both highland and midland areas, which were brought to the Torra Municipality Abattoir. The study included both young animals (less than 2 years old) and adult animals (between 2 and 5 years old). These animals came from various livestock potential zones within the Silte and Gurage zones of Central Ethiopia Regional State.

2.3 Study Design

A methodical approach of systematic random selection was employed for laboratory testing and an active abattoir survey as part of a comprehensive study on bovine hydatid cysts.

2.4 Determination of sample size

The necessary number of animals for the study was calculated using Thrusfield's formula (2018) since the estimated previous prevalence of the area was unknown. Consequently, a predicted prevalence of 50% was chosen, with an absolute precision (d) of 5% (0.05) and a confidence level of 95%. This led to the selection of 384 animals for the study to identify hydatid cysts. The formula used for calculating the sample size was:

$$n = P(1-P) \times Z^2 / d^2$$

Where, n= sample size
z= given coefficient (1.96)
d= up to 5% error (0.05)
p= expected prevalence

2.5 Study Methodology

2.5.1 Ante-mortem Inspection

During the pre-mortem examination, records were made on the species, breed, sex, age, and origin of the animals. The age of the animals was estimated based on their dental characteristics, which were then categorized into two groups: young (less than two years) and mature (two to five years). Each animal was assigned a unique identification number prior to slaughter.

2.5.2 Post-mortem Inspection

Following the slaughter, the heart, liver, kidney, tongue, and lungs were inspected for the presence of hydatid cysts using established meat inspection techniques. This involved visual and tactile examination of the muscles and organs, followed by further incisions into each organ if hydatid cysts were detected. The number of cysts found in each organ and animal was recorded. This process was carried out in accordance with the guidelines set by the Ministry of Agriculture (1972), which detailed the procedure for examining the heart and lung, including the cardiac muscle, and for dissecting the shoulder muscle to access the pericardium. Deep, parallel cuts were made from the elbow to the shoulder muscle.

2.6 Cyst Evaluation

An additional set of tests was conducted to assess the dimensions, reproductive capacity, and health of the cysts. The categorization of cyst sizes was based on their diameter, with small cysts (less than 5cm), medium cysts (5-10cm), and large cysts (greater than 10cm) measured with a ruler as outlined by Oostburg et al. (2000).
A sterile hypodermic needle was employed to reduce the pressure within the cyst. Following this, the cyst was opened with a sterile scalpel blade, and its contents were transferred to a glass Petri dish. The fluid was then examined for the presence of protoscolices, either within the fluid or attached to the germinal layer as a wide capsule. Cysts were considered fertile if protoscolices were observed as white specks on the germinal epithelium, broad capsules, or hydatid sand in suspension.

Conversely, if no protoscolices were found, the cysts were classified as sterile. A viability test was then performed on the fertile cysts. A sediment drop containing protoscolices was placed on a small glass slide, covered with a cover slip, and viewed under a compound microscope set to 40x magnification. The method involved identifying between living (unstained) and dead (stained) protoscolices by adding a drop of 0.1% aqueous Eosin solution to a sample of protoscolices from the hydatid fluid on the slide. The principle behind this method was that living protoscolices should partially or completely exclude the dye, whereas dead ones would absorb it (FAO, 2003; Teshale *et al*., 2024).

2.7 Financial loss estimation

The following elements were considered in calculating the economic losses associated with the condemnation of organs. These elements included statistics on the average yearly slaughter rate of cattle at the Torra Municipal Abattoir, which were derived from historical records, and the average retail market prices of the organs (liver, spleen, heart, kidney, and lung) in Torra town, collected from local butchers during the study period. The economic loss from condemned organs was determined using the formula:

$$EL = \Sigma srx \times Coy \times Roz$$

Where:

EL = Annual economic loss estimated due to organ and carcass condemnation from the international market.

Σsrx = Annual cattle slaughter rate of the abattoir,

Coy = Average cost of each liver/ lung/ heart/ tongue, and

Roz = Condemnation rates of cattle /liver/lung/heart/tongue

2.8 Data Management and Analysis

The significant difference between the variables in the occurrence of the hydatid cyst was determined using Pearson's chi-square (X^2). For analysis, SPSS version 25 software was utilized.

3 Results

3.1 Active Abattoir Survey

In the study of 384 animals at the Torra Municipal Abattoir, it was found that 66 animals had different types of hydatid cysts, with a prevalence rate of 17.2%. When looking at the presence of bovine hydatid cysts, there was no significant difference ($p > 0.05$) found between the animals based on where they came from or their sex. The animals with the highest rate of hydatid cysts were from Kikora 7 (25.93%), followed by Warsha 12 (23.5%), Shanka 5 (19.2%), Rape 8 (18.6%), Sostoro 3 (15.8%), Luke 6 (15.4%), Maja 13 (14.6%), Ameche 10 (13.2%), and the lowest Kusaya 2 (10.5%) (Table 1). Most of the infected animals, 52 (78.8%), had only one organ or tissue affected by the cysts, while the remaining 14 (21.21%) had multiple organs affected.

Table 1: Prevalence of Bovine hydatidosis in the origin of the animals

Origin	Examined	Infected	Prevalence
Kikora	27	7	25.93%
Worsh	51	12	23.5%
Shanka	26	5	19.2%
Rape	43	8	18.6%
Sostoro	19	3	15.8%
Luke	39	6	15.4%
Maja	89	13	14.6%
Amiche	76	10	13.2%
Kusaya	19	2	10.5%
Total	**384**	**66**	**17.2%**

X^2= 6.3715 p= 0.606

Among the affected muscles and organs, the lung exhibited the highest anatomical distribution of bovine hydatid cysts (Table 2). There was a notable difference in the anatomical distribution of the organs examined, according to an analysis of the active abattoir survey.

Table 2: The prevalence of bovine hydatid cyst based on organ and anatomical distribution

Organ examined	Examined	Infected	Prevalence
Lung	384	23	6%
Liver	384	18	4.7%
Lung and Liver	384	14	3.6%
Heart	384	6	1.6%
Tongue	384	5	1.3%
Total	**384**	**66**	**17.2%**

Based on sex the higher prevalence was in females 13(22.81%) and lower in males 53(16.21%) (Table 3).

Table 3: Prevalence of bovine hydatid cyst based on sex of animals examined

Sex	Examined	Infected	Prevalence
Male	327	53	16.21%
Female	57	13	22.81%
Total	**384**	**66**	**17.2%**

$X^2 = 1.1323$ $p = 0.287$

Bovine hydatid cysts have been found to affect 63 out of 362 adult animals, or about 17.4%. On the other hand, only 3 out of 22 young animals were infected, showing a rate of 13.64% among them. The age of the animals and the rate of infection showed no clear relationship (p>0.05) based on the study (Table 4).

Table 4: Prevalence of bovine hydatid cyst age wise

Age	Examined	Infected	Prevalence
Young	22	3	13.64%
Adult	362	63	17.4%
Total	**384**	**66**	**17.2%**

$X^2 = 2.4097$ $p = 0.12$

3.2 Viability Test

In the course of this investigation, 66 animals at the Torra Municipal Abattoir provided a total of 112 cysts; 44 (or 39.29%) of these cysts were viable, while 68 (or 60.71%) were calcified (Table 5).

Table 5: Viability of bovine hydatid cyst in affected organs.

Affected organ	Cyst status		Total	Prevalence (%)
	Viable cyst	Calcified cyst		
Lung	12(30%)	28(70%)	40	35.7
Liver	13(43.3%)	17(56.7%)	30	26.8
Heart	3(37.5%)	5(62.5%)	8	14.6
Tongue	2(76.9%)	5(71.4%)	7	6.25
Lung &liver	14(51.85%)	13(48.14%)	27	24.12
Total	**44(39.29%)**	**68(60.71%)**	**112**	**17.2**

The annual slaughter rate of the abattoir was estimated to be 2400 cattle based on the data from result retrospective study of the Torra municipality abattoir. The annual estimated economic loss was found to be Liver (27.3%), Lung and Liver (21.2%), Heart (9.1%), Tongue (7.6%) & Lung (34.8%), respectively, and losses by money 165,817.55 ETB (US$ 2,909) per annum (Table 6).

Table 6: Annual economic losses due to hydatidosis

No	Condemned organs	% Condemned	Unit Price (ETB)	Loss (ETB)
1	Lung (23)	34.8	55	46,000
2	Liver (18)	27.3	100	65,454.55
3	Lung and Liver (14)	21.2	75	38,181.18
4	Heart (6)	9.1	45	9,818.18
5	Tongue (5)	7.6	35	6,363.64
Total	**66**	**100**	**310**	**165,817.55 ($2,909)**

Annual slaughter rate (2400 cattle)

4 Discussion

In this study, 66 out of 384 animals checked at the Torra Municipal Abattoir were found to have bovine hydatid cysts, indicating a prevalence rate of 17.2%. This prevalence rate closely matches the results reported by Lechamo and Geinoro (2019) (17.2%) in Doyogena, Omadang *et al*. (2024) (15.2%) in Uganda, Tadesse *et al*. (2014) (17.1%) in Nekemte. This result is lower than the result of Guduro and Desta (2019) (52%) in Southern Ethiopia, Getaw *et al*. (2010) (46.8%) in Adama and higher than the results of Akeberegn *et al*. (2017) (6.51%) in North Shoa, Ahmed *et al*. (2024) (10.7%) in Gondar, and Jawad *et al*. (2018) (1.84%) in Iraq. Generally, the difference in how often hydatidosis occurs in various areas is linked to the genetic diversity of *E. granulosus* found in those areas. Moreover, this difference might also be attributed to the age of the animals, along with other elements such as cultural differences, economic activities, and views on dogs and their communities (Ahmed *et al*., 2024; Mohamed *et al*., 2024; Yirsa *et al*., 2024).

In the research conducted, there was no link ($p > 0.05$) found between sex, country of origin, breed, and the occurrence of bovine hydatid cysts. When examined by sex, the analysis showed no statistically significant difference in prevalence rates between males (53, 16.21%) and females (13, 22.81%). This finding aligns with the studies by Ahmed *et al*. (2024) and Yirsa *et al*. (2024). It could be attributed to the fact that both sexes were feeding on the same pastures and shared a similar management approach in the area under investigation.

The majority of the animals brought to the study abattoir for slaughter originated from the peasant associations of Kusaya, Ameche, Maja, Sostoro, Shanka, Warsha, and Kikora. Even though there was a slight variation in the prevalence among different origins, not statistically significant ($p > 0.05$), and this agrees with the report of Dawit *et al*. (2013) in Mekelle. An explanation for the lack of significance in variance could be that the majority of the animals slaughtered in this abattoir came from backgrounds with comparable breeds and management practices.

The prevalence of bovine *hydatid cyst* was higher (17.4%) in adults when compared to young (13.64%) and statistically no significant ($p > 0.05$) between age groups. Similar to the present findings, it was reported that cystic echinococcosis infection was higher in older animals as reported by Azlaf and Dakk (2006) and Omadang *et al*. (2024). This could be mainly because aged animals have a longer exposure time to *E. granulosus* eggs. In addition, older animals might have weaker immunity to combat infection as reported by Shaw *et al*. (2013). This significant variation in the prevalence of bovine *hydatid cysts* might be due to, their tethering system of grazing.

During this study, bovine hydatid cyst was distributed in organs inspected with, the lung and liver being the most frequently affected organs with the highest number of cysts but the tongue was the least one. Accordingly, the most frequently affected organ with the highest number of cysts was the lung which is in agreement with the reports of Aydin *et a1*. (2021) and Yirsa *et al*. (2024).

The viability test of the cysts revealed that the liver and lung were the most viable, followed by the heart, tongue, liver, and lung, in that order. The distribution of cysts in animals is influenced by geographical and environmental factors, affecting where the cysts are most likely to be found during the inspection of meat (Bekele *et al*., 2017).

5 Conclusion

Our investigation at the Torra Municipal Abattoir unveiled a noteworthy prevalence rate of bovine hydatid cysts, with 66 out of 384 animals examined testing positive, indicating a prevalence rate of 17.2%. This finding underscores the significant burden of bovine hydatidosis in the region and highlights the necessity for targeted interventions to address this parasitic infection. Furthermore, our study illuminated the substantial economic impact of bovine hydatid cysts, particularly through organ condemnations, which underscores urgent need for comprehensive control measures. Overall, our research provides important insights into the prevalence and economic effects of bovine hydatidosis, emphasizing the importance of proactive measures to reduce its impact on both livestock production and public health.

5.1 Recommendations

In line with the findings, we advocate for the implementation of rigorous meat inspection protocols at abattoirs and the enhancement of environmental hygiene practices to reduce the prevalence of bovine hydatid cysts. Public awareness campaigns on the risks associated with consuming contaminated meat and the importance of proper sanitation are essential to prevent the spread of *Echinococcus granulosus*. Moreover, we suggest additional studies to investigate the indirect financial impacts and wider health consequences of bovine hydatid cysts, which will aid in creating more focused measures and well-informed policy choices. It is imperative that stakeholders collaborate to address this multifaceted issue effectively and safeguard both livestock and human health.

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References:

Ahmed, M. A., Ahmed, C., & Mengistu, A. (2024). A Study on Prevalence and Economic Significance of Bovine Hydatidosis in Haramaya Muncpial Abattoir. *Veterinary Medicine and Animal Science*, 7, 1135.

Akeberegn, D., Alemneh, T., & Kassa, T. (2017). The prevalence of bovine hydatidosis among slaughtered cattle at Debre Berhan municipal abattoir, north Shewa zone, Ethiopia. *Journal of Veterinary Science and Medicine*, *5*(1), 5. https://doi.org/10.13188/2325-4645.1000030

Aydin, Y., Ulas, A. B., Ince, I., Korkut, E., Ogul, H., Eren, S. ... & Eroglu, A. (2021). Large case series analysis of cystic echinococcosis. *Indian Journal of Surgery*, *83*(Suppl 4), 897-906. https://link.springer.com/article/10.1007/s12262-021-03061-0

Azlaf, R., & Dakkak, A. (2006). Epidemiological study of the cystic echinococcosis in Morocco. *Veterinary parasitology*, *137*(1-2), 83-93. https://doi.org/10.1016/j.vetpar.2006.01.003

Basore, B. A., Alleyo, T. G., & Tolera, B. (2018). Gross Pathological Abnormalities and Related Economic Loss in Slaughtered Cattle at Dire Dawa Municipal Abattoir, Eastern Ethiopia. *European Journal of Applied Sciences*, *10*(4), 104-111. https://doi.org/10.5829/idosi.ejas.2018.104.111

Bekele, D., Berhanu, B., & Pal, M. (2017). Studies on the prevalence, cyst viability, organ distribution, and public health significance of bovine cysticercosis in Ambo municipality abattoir, western Shoa, Ethiopia. *Journal of Parasitology and Vector Biology*, *9*(5), 73-80. http://www.academicjournals.org/JPVB

Christofi, E. (2022). Cystic Echinococcosis: An Impact Assessment of Prevention Programs in Endemic Developing Countries in Africa, Central Asia, and South America. *Journal of Zoological Systematics and Evolutionary Research*, *2022*, 1-28. https://doi.org/10.1155/2022/8412718

Dawit, G., Adem, A., Simenew, K., & Tilahun, Z. (2013). Prevalence, cyst characterization and economic importance of bovine hydatidosis in Mekelle municipality abattoir, Northern Ethiopia. *Journal of Veterinary Medicine and Animal Health*, *5*(3), 81-86. https://doi.org/10.5897/JVMAH2013.0202

FAO. (2003). *Diagnosis manual on meat inspection for developing counters*.

Fesseha, H., & Asefa, I. (2022). Co-infection of fasciolosis and hydatidosis and their financial loss in cattle slaughtered at Wolaita Sodo municipal abattoir, southern Ethiopia. *Animal Diseases*, *2*(1), 27. https://doi.org/10.1186/s44149-022-00059-3

Fu, M. H., Wang, X., Han, S., Guan, Y. Y., Bergquist, R., & Wu, W. P. (2021). Advances in research on echinococcosis epidemiology in China. *Acta Tropica*, *219*, 105921. https://doi.org/10.1016/j.actatropica.2021.105921

Getaw, A., Beyene, D., Ayana, D., Megersa, B., & Abunna, F. J. A. T. (2010). Hydatidosis: prevalence and its economic importance in ruminants slaughtered at Adama municipal abattoir, Central Oromia, Ethiopia. *Acta tropica*, *113*(3), 221-225. https://doi.org/10.1016/j.actatropica.2009.10.019

Guduro, G. G., & Desta, A. H. (2019). Cyst viability and economic significance of Hydatidosis in southern Ethiopia. *Journal of parasitology research*, *2019*. https://doi.org/10.1155/2019/2038628

Habtie DW. (2019). *Prevalence and Potential Risk Factors of Human Cystic Echinococcosis in Selected Districts of South Omo Zone*. Ethiopia (Doctoral dissertation, Addis Ababa University Addis Ababa, Ethiopia).

Harder, A., & Mehlhorn, H. (2014). Liver Diseases (Abscesses, Tissue Cysts and Tumours) Caused by Parasites. *Treatment of Human Parasitosis in Traditional Chinese Medicine*, 79-115. https://doi.org/10.1007/978-3-642-39824-7_7

Hogea, M. O., Ciomaga, B. F., Muntean, M. M., Muntean, A. A., Popa, M. I., & Popa, G. L. (2024). Cystic

Echinococcosis in the Early 2020s: A Review. *Tropical Medicine and Infectious Disease*, *9*(2), 36. https://doi.org/10.3390/tropicalmed9020036

Jawad, R. A., Sulbi, I. M., & Jameel, Y. J. (2018). Epidemiological study of the prevalence of hydatidosis in ruminants at the Holy City of Karbala, Iraq. *Annals of parasitology*, *64*(3). https://doi.org/10.17420/ap6403.154

Kulesh, R., Vareshva, R., Verma, R., & Suman, A. (2022). Occurrence of hydatid cyst in cattle of Mandla district of Madhya Pradesh. *11*(2), 1904-1906. http://www.thepharmajournal.com/

Lanfiro Woreda Agricultural Office. (2023).

Lechamo, M., & Geinoro, T. (2019). Prevalence and Financial Significance of Bovine Hydatidosis at Doyogena Woreda Municipal abattoir, Southern Ethiopia. *Prevalence*, *4*(3), 53-59. www.advancedjournal.com

Little, C. (2024). *The Dog Care Handbook: Things I Wish My Vet Had Told Me*. 5m Books Ltd.

Mazengia, H., Wondimagegn, K. A., Driver, B. M. F., & Chakeredza, S. (2017). Livestock Production in Africa for Increased Resilience. *Agricultural Risk Management in Africa*, 128.

Mohamed, S. A., Elbahy, N. M., & Elkhatam, A. O. (2024). Hydatidosis in Menoufia's three Abattoirs, Egypt: Epidemiological, Histopathological, Economic, and Molecular Insights in Cattle and Buffaloes. *Journal of Current Veterinary Research*, *6*(1), 285-299. https://doi.org/10.21608/jcvr.2024.352719

Odero JK. (2015). *The burden of Cystic Echinococcosis in selected regions in Kenya*. (Doctoral dissertation).

Ogurinade, A., & Ogunrinade, B. I. (1980). Economic importance of bovine fascioliasis in Nigeria. *Tropical animal health and production*, *12*(3), 155-160. https://doi.org/10.1007/bf02242647

Omadang, L., Chamai, M., Ejobi, F., Erume, J., Oba, P., & Ocaido, M. (2024). Prevalence of cystic echinococcosis among livestock in pastoral and agro-pastoral areas in Uganda. *Parasitology*, *151*(1), 68-76. https://doi.org/10.1017/S0031182023001154

Oostburg, B. F. J., Vrede, M. A., & Bergen, A. E. (2000). The occurrence of polycystic echinococcosis in Suriname. *Annals of Tropical Medicine & Parasitology*, *94*(3), 247-252. https://doi.org/10.1080/00034983.2000.11813536

Peralta, R. D. C., Cuntó, R. A. C., Moreta, C. Y., Lapo, G. E. G., Sierra, R. L. V., Villalba, L. R. L., ... & Ramallo, G. (2023). Zoonotic Transmission of Hepatic Hydatid Cyst from Domestic Dogs: A Case Report from an Urban-Marginal Area in Ecuador. *The American Journal of Case Reports*, *24*, e940647-1. https://doi.org/10.12659/ajcr.940647

Pourseif, M. M., Moghaddam, G., Saeedi, N., Barzegari, A., Dehghani, J., & Omidi, Y. (2018). Current status and future prospective of vaccine development against *Echinococcus granulosus*. *Biologicals*, *51*, 1-11. https://doi.org/10.1016/j.biologicals.2017.10.003

Shaw, A. C., Goldstein, D. R., & Montgomery, R. R. (2013). Age-dependent dysregulation of innate immunity. *Nature Reviews Immunology*, *13*(12), 875-887. https://doi.org/10.1038/nri3547

Sissay, M. M., Uggla, A., & Waller, P. J. (2007). Prevalence and seasonal incidence of nematode parasites and fluke infections of sheep and goats in eastern Ethiopia. *Tropical Animal Health and Production*, *39*, 521-531. https://doi.org/10.1007/s11250-007-9035-z

Tadesse, B., Birhanu, T., Sultan, A., Ayele, G., & Ejeta, E. (2014). Prevalence, public significance, and financial loss of hydatid cyst on cattle slaughtered at Nekemte municipal abattoir, Western Ethiopia. *Acta Parasitologica Globalis*, *5*(3), 151-159.

Taghipour, A., Ghodsian, S., Jabbari, M., Olfatifar, M., Abdoli, A., & Ghaffarifar, F. (2021). Global prevalence of intestinal parasitic infections and associated risk factors in pregnant women: a systematic review and meta-analysis. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, *115*(5), 457-470. https://doi.org/10.1093/trstmh/traa101

Teshale, N., Amare, A., Feyisa, A., & Abosse, J. S. (2024). Pathological characterization of pulmonary lesion and identification of associated bacteria and parasite infection in sheep and goat slaughtered at Dessie municipal abattoir, North-East Ethiopia. *Surgical and Experimental Pathology*, *7*(1), 3. https://doi.org/10.1186/s42047-024-00147-3

Thompson, R. C. A. (2017). Biology and systematics of Echinococcus. *Advances in parasitology*, *95*, 65-109. https://doi.org/10.1016/bs.apar.2016.07.001

Thrusfield M. (2018). *Veterinary epidemiology*. John Wiley & Sons.

Udainiya, S., Tiwari, A., Mishra, A., & Dubey, A. (2024). Zoonotic diseases of dogs and cats. In *Introduction to Diseases, Diagnosis, and Management of Dogs and Cats* (pp. 559-572). Academic Press.

Urquhart GM, Armour J, Duncan JL, Dunn AM, Jenning FW. (1996). *Veterinary parasitology, UK: black well science, 2nd edition*. 257-271.

Yirsa T, Mulugeta T, Berihun A. (2024). Cattle Hydatidosis occurrence, cyst characterization and associated risk factors at Wolaita Soddo Municipality Abattoir, Southern Ethiopia. *Research Square*, Apr 24.