American Journal of Zoology
2025, Vol. 8, No. 3, pp. 60-65
https://doi.org/10.11648/j.ajz.20250803.11

Research Article

Prevalence, Organ Distribution and Risk Factors Associated with Hydatidosis in Camels Slaughtered at Akaki Municipal Abattoir, Addis Ababa, Ethiopia

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Abstract

Hydatidosis is a parasitic zoonosis caused by the larval stage of *Echinococcus granulosus*, posing significant public health and economic concerns in camels. A cross-sectional study was conducted from November 2018 to April 2019 to determine the prevalence of camel hydatidosis and its associated risk factors in camels slaughtered at Akaki Municipal Abattoir, Addis Ababa, Ethiopia. A total of 364 camels were randomly selected and subjected to ante-mortem and post-mortem examination. Sex, age, body condition, and origin were recorded before thorough inspection of the lungs, liver, spleen, heart, and other organs for hydatid cysts. The overall prevalence of hydatidosis was 53.6% (195/364). Females (64.5%) and older camels (>10 years; 57.7%) showed significantly higher infection rates. Camels with medium body condition had a higher prevalence (59.4%) than those in good condition. Statistically significant associations ($p = 0.00$) were found between hydatidosis and sex, age, and body condition, while origin showed no significant association ($p > 0.05$). Among 239 infected organs, the lungs were the most frequently affected (60.7%), followed by the liver (34.4%), spleen (3.7%), and heart (1.2%). Of 736 collected cysts, 494 were found in the lungs and 222 in the liver, with 157 (21.3%) fertile, 545 (74.1%) sterile, and 122 (16.6%) calcified cysts. The high prevalence of hydatidosis highlights a lack of awareness in the camel-producing areas. Therefore, public education and targeted control strategies are recommended to reduce the burden of the disease.

Keywords

Hydatidosis, Camel, Prevalence, Akaki Abattoir, Ethiopia

1. Introduction

Camels are among the most resilient animals, well-adapted to thrive in marginal areas and harsh environmental conditions. Numerous pastoral communities across various ecological zones globally rely on camels as a key component of their livelihood. The global camel population is estimated at approximately 25 million, with about 11 million found in arid and semi-arid regions—especially in the dry lowlands of East Africa [1] In Ethiopia, the camel population is about 2.4 million, with 92% of them being raised in the Somali and Afar regional states [2]. Camels have a significant role in providing draught power and influencing the economic, social, and food security status of pastoralists in the lowlands and

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Received: 25 July 2025; **Accepted:** 8 August 2025; **Published:** 9 September 2025

mid-altitudes of Africa, including Ethiopia [3].

However, diseases in camels cause considerable economic losses due to condemnation of edible organs, decreased meat /milk production and reduced draft power [4]. Among the camel diseases, hydatidosis (*cystic Echinococcosis*) is highly prevalent, with substantial economic and public health importance. It is caused by the larval stage of *Echinococcus granulosus*, which has an indirect life cycle involving both domestic and wild carnivores [5]. Dogs are the main source of infection, although in some areas, jackals, foxes and wolves could also play a role as definitive hosts. These hosts become infected by consuming hydatid cysts found in the tissues of infected intermediate hosts. The cysts contain viable protoscoleces that develop into adult worms within the intestines of the definitive hosts. A wide range of domestic, wild mammals and humans act as intermediate hosts for this parasite, where the larval stages (hydatid cyst) develop after ingesting the eggs [6]. The infective eggs containing the oncosphere passed in feces are accidentally ingested by camels, sheep, pigs, cattle, and other animals or humans, which act as intermediate hosts. The oncosphere in the eggs penetrates the intestine and reaches the liver, lungs, and other organs, including the brain and muscles, to develop hydatid cysts. Hydatidosis is a global human and animal health problem with increasing economic and public health importance [7, 8]. In particular, the movement of infected livestock increases the potential for transmission, thus creating new areas of endemicity [9].

The public health and economic significance of hydatidosis lies on the cost of hospitalization, medical and surgical fees, loss of income and productivity due to permanent or temporary incapability to work. The social consequence of hydatidosis is disability and mortality [10]. In food animals, hydatidosis causes decreased production of meat, milk, wool, reduction in growth rate and predisposition to other diseases [11]. In Ethiopia, hydatidosis is known to be an important economic and public health significance in all parts of the country. Many researchers have reported hydatidosis in large and small ruminants; however, only a few findings have been reported in camels. Considering the importance of the disease and disease prevention and control strategy, it is important to assess and quantify the current status of the disease. Hence, this research work aimed to determine the prevalence, organ distribution and risk factors associated with camel hydatidosis at Akaki municipal abattoir.

2. Materials and Methods

2.1. Study Areas

Akakin abattoir is located in Addis Ababa, the capital city of Ethiopia. Addis Ababa is located at 9°1’48’ North and 38° 44 ̍-24’ East at an average altitude of 2500 m above sea level.

2.2. Study Population

The study animals were local camels (*Camelus dromedarius*) that came from arid and semi-arid zones, primarily from Borena, Metahara, and Minjar. In these regions, camels play a vital role in the socio-economic and cultural life of pastoral communities, serving as sources of transport, meat, milk, and income. The camels brought to the abattoir were both male and female, varied in age and body condition, reflecting the diverse management and environmental conditions of their areas of origin.

2.3. Study Design

This study employed a cross-sectional design aimed at assessing the prevalence of camel hydatidosis and identifying associated risk factors in camels slaughtered at the Akaki Abattoir from November 2020 to April 2021.

2.4. Sample Size Determination and Sampling Technique

The total number of camels required for this study was calculated based on the formula given by Thrusfield [12]. Since there was previous information about camel hydatidosis in Akaki abattoir, with the prevalence of 61.6% as reported by Bulto et al [13]. The expected prevalence was taken as 61.6% with 5% desired level of precision and a 95% confidence interval. Therefore, the sample size was calculated based on the following formula:

$$N = \frac{1.96^2 Pexp\,(1-Pexp)}{d^2}$$

Where N= required sample size, P exp = expected prevalence, d=desired absolute precision, 1.962 = z-value for 95% confidence interval.

Based on the above formula, the study was conducted on a total of 364 camels, which were selected using simple random sampling techniques from 600 camels presented for slaughter.

2.5. Study Methodology

2.5.1. Ante Mortem Inspection

During ante mortem inspection, factors such as age, sex, body condition score and origin of individual camel were recorded. The age of camels was determined by dental eruption according to Khan et al [14] and the body condition scoring was carried out based on the guidelines given by Faye at al [15]. The scoring was conducted by looking at the back and flank and then classified as poor (0 and 1), medium (2 and 3), and good (4 and 5).

2.5.2. Post Mortem Inspection

During post mortem, visceral organs including lungs, liver, spleen, heart, kidneys and other viscera, were examined through visualization, palpation and systemic incision of each

organ for the presence and absence of hydatid cyst. The number and size of cysts (small, medium and large) in each organ were recorded and collected in plastic bags for fertility tests.

2.5.3. Determination of Fertility of the Cyst

The collected cysts were carefully incised and examined for protoscolices, which look like white dots on the germinal epithelium, in hydatid fluid so as to classify cysts as fertile or infertile based on presence or absence of protoscolices. For further confirmation, the content (a fluid) were examined under microscope (40X). If protoscolices are found in the fluid or on germinal layer then the cyst can be classified as fertile cyst and the cyst is infertile if no protoscolices are seen. The infertile cysts were further classified as sterile (fluid-filled cysts without any protoscolices) or calcified [11]. The diameter of collected cysts was measured and classified as small (<5 cm), medium (5-10 cm) and large cyst (>10 cm) [16].

2.6. Ethical Considerations

Ethical considerations in this study were taken from research ethical review committee of the school of Veterinary Medicine, Wollega University by the Certificate Ref. No: VMERC 24/05/2020. Since the research method is questionnaire method, there was no animal involvement in the research. However, ethical consideration used in this research was, being reliable to animal owners. All activities were carried out in accordance with the ethical guideline of the school of Veterinary Medicine after receiving the ethical approval.

2.7. Data Management and Analysis

The raw data stored in excel spread sheet was analyzed by SPSS statistical software, version 20. The presence of association between the occurrence of hydatidosis and the possible associated risk factors (age, sex, body condition and origin) analyzed using chi-square stastical test. For all statistical analysis p value < 0.05 was considered as significant level.

3. Results

3.1. Over all Prevalence of Hydatidosis

From a total of 364 camels examined for presence of hydatidosis in Akaki abattoir, 195 camels were found to be infected with hydatid cyst with an overall prevalence of 53.6% (195/364). (Table 1)

3.2. Risk Factors Associated with the Prevalence of Camel Hydatidosis

Our data demonstrated that female camels had higher prevalence (64.5%) than males (45.8%) which was statistically significant (P<0.05) thes two sexes. Age wise analysis revealed that older camels, particularly those over 10 years of age, had a higher prevalence (57.7%) when compared to those aged 5 to 10 years (25.5%). This difference was found to be statistically significant (P < 0.05). Similarly, camels with medium body condition showed a higher prevalence (59.4%), whereas those with good body condition had a lower prevalence (29.6%). The difference in hydatidosis occurrence between the two body condition categories was also statistically significant (P < 0.05) (Table 1). The prevalence of hydatidosis was compared among camels originating from Borena, Metahara, and Minjar. The results indicated that camels from Minjar were slightly more affected than those from Borena and Metahara. However, the difference in prevalence among these three regions was not statistically significant (P > 0.05).

Table 1. *Prevalence of Camel Hydatidosis Based on Sex, Age, BCS and Origin of Animal.*

Risk factors	Total camels examined	No of positive camels	Prevalence (%)	Chi-square value	P-Value
Sex					
Male	212	97	45.8	12.47	0.00
Female	152	98	64.5		
Age					
5-10 years	47	12	25.5	17.05	0.00
>10 years	317	183	57.7		
Body condition score					
Medium	293	174	59.4	20.42	0.00
Good	71	21	29.6		
Origin					

Risk factors	Total camels examined	No of positive camels	Prevalence (%)	Chi-square value	P-Value
Borena	181	96	53.00		
Methara	83	40	48.2	2.17	0.338
Minjar	100	59	59		
Total	364	195	53.6		

3.3. Organ Distribution and Cyst Fertility

A total of 736 cysts were collected from different visceral organs of the camel. Lungs were the most frequently affected organ by hydratid cyst, followed by liver, spleen and heart. Figure 1 shows the organ distribution of hydatid cysts. Of the total 736 cysts collected, 157 cysts are fertile while 545 are sterile and 122 are calcified (Figure 2).

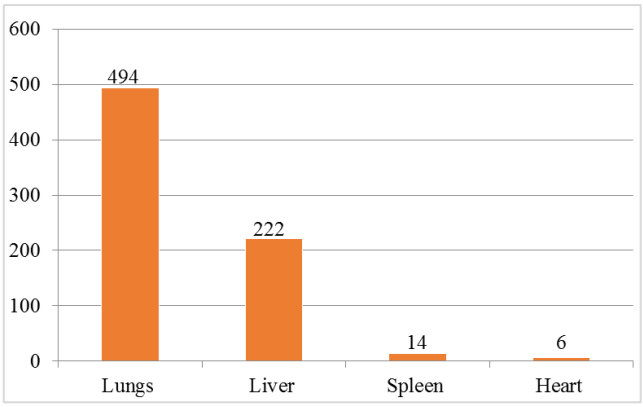

Figure 1. *Organ distribution of hydatid cysts in camel.*

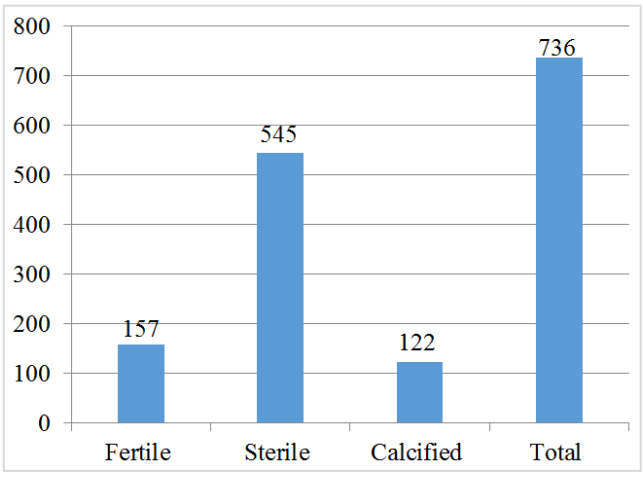

Figure 2. *Cyst fertility and sterility in camels.*

4. Discussion

Considering the public health and economic significances of hydatidosis a cross sectional study was conducted on camels slaughtered at Akaki municipal abattoir and an overall prevalence of 53.6%was recorded. The prevalence of hydatidosis in this study was higher when compared to the finding of Adisalem *et al* [17] (28.67%) in Dire Dawa municipal abattoir, Muskin *et al.* [18] (22.6%) at Akaki abattoir, Ahimed [19] (18.6%), Weldemeskel [20] (18.86%) and Wubet [21] (4.4%) in Eastern Ethiopia. On the other hand the current prevalence of camel hydatidosis was relatively lower when compared with previous reports of Bulto *et al* [13] (61.6%) in Akaki municipal Abattoir and some other report in the world, in Morocco Pandev *et al.* [22] (80%), in Kenya Njorge *et al* [23] (61.4%). These variations of the prevalence could be due to the variation in the temperature, environmental conditions, livestock heath practice, the nature of pasture and the way of rising and grazing of these animals. The other possible reason for the variation in the prevalence rate in different countries and regions may be attributed mainly to strain difference of *E. granulosus* that exist in different geographical locations [24].

In relation to sex of camels, prevalence of hydatidiosis in female was higher which accounts 64.5%, whereas low prevalence of hydatidiosis in was recorded in males (45.8%). Variation in occurrence of hydatidosis between sex was statistically significant ($P<0.05$). This result was in agreement with the previous finding reported by [13, 18, 19, 25-28]. This might be due to females remain longer than males for reproductive purposes in the area. This may increase the probability of having more infection and resulting in higher prevalence. The result showed that there was significant variation between age groups for the infection with hydatidosis where the prevalence in animals above 10 years of age was significantly higher ($P<0.05$) than that of 5-10 years. This result was in agreement with the findings of [13, 18, 24]. This could be mainly because aged animals have longer exposure time to eggs of *E granulosus* in addition to weaker immunity to combat against the infection [29]. This might also be related with the general fact that most of the camels are slaughtered in their old age when their milk and or calf production and working capacity get reduced.

The prevalence of hydatidosis was higher in camels having

medium body condition score when comparing with that of good body condition and which might be related with the fact that in moderate to serve infection, the parasite may cause reduced performance and growth, as well as live weight loss. In this study there was no statically significant relation between origin of animal and occurrence of the disease (P>0.05). The reason for the absence of variation in the prevalence in those different places may be related with the presence of very similar environmental situation in all areas. The result on organ prevalence study showed that lungs were found to be most commonly affected organs followed by live. This result was in agreement with [20, 24, 29]. The disease was common both in lung and live this might be due to the reason that lung and liver possess greater capillaries that act as partial barriers for the ingested hexachant embryos taking the portal vein route and primarily negotiate the hepatic and pulmonary system sequentially before any other peripheral organ invasion [30]. Fertility rate among the organs was higher in lungs (27.8%) followed by liver (25.9%), and spleen (21%). This result agreed with Bulto et al [13] in Ethiopia, and this higher fertility in lungs was due to the spongy consistency of the lung that allows the easy development of cysts [30].

5. Conclusion

In conclusion, our findings demonstrated hydatidosis is a widespread problem in camels originating from Borena, Minjar, and Metahara, which has significant economic and public health consequences. Hence, it is essential to strengthen meat inspection services to ensure food safety. Improving waste disposal practices by establishing effective systems for the safe disposal of condemned organs will help prevent access by dogs and other scavengers that contribute to disease transmission. Public awareness campaigns should be conducted to educate pastoralists, butchers, and the general community about the risks, transmission, and prevention of hydatidosis. Additionally, promoting the construction of standardized and well-equipped abattoirs in camel-rearing regions will support hygienic slaughter practices and reduce environmental contamination. Implementing comprehensive dog control measures—including regular deworming, registration, and control of stray dog populations—is also critical in breaking the disease cycle. Finally, further research is needed to deepen understanding of the epidemiology and transmission of hydatidosis, which will aid in developing more effective, evidence-based control strategies. Together, these actions can significantly reduce the burden of camel hydatidosis and improve public health, food safety, and economic outcomes in the affected areas.

Acknowledgments

We would like to express our gratitude to Wollega University School of Veterinary Medicine for enabling us to use laboratory to conduct this research.

Authors Contributions

Abraham Kebede: conceptualization, supervision, analysis and editing of the manuscript

Ayansa Tilahun: conceptualization, data collection and writing original draft, data analysis, preparation and editing of the manuscript

Declarations Ethics Approval and Consent to Participate

To conduct this research, we have taken ethical clearance certificate from the research ethical committee of Wollega University and performed accordingly.

Funding

No funding was received for this manuscript.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Conflict of Interest

The authors declare no conflicts of interest.

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