



ISSN Print: 2664-9926
 ISSN Online: 2664-9934
 NAAS Rating (2026): 4.82
 IJBS 2026; 8(6): 162-166
www.biologyjournal.net
 Received: 05-03-2026
 Accepted: 08-04-2026

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Hydatidosis as a major cause of organ condemnation and economic losses in cattle slaughtered at Ibadan central abattoir, Southwestern Nigeria

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DOI: <https://www.doi.org/10.33545/26649926.2026.v8.i6b.926>

Abstract

Hydatidosis remains one of the most economically devastating parasitic diseases of livestock worldwide, yet its prevalence and economic impact at slaughterhouses in Nigeria remain insufficiently documented. This research was designed to determine the prevalence, organ distribution, cyst characteristics, and economic significance of bovine hydatidosis in cattle slaughtered at Ibadan central abattoir, Southwestern Nigeria, from March 2022 to February 2023. A total of 924 cattle were examined through systematic ante-mortem and post-mortem inspections. The overall prevalence of hydatidosis was 28.6% (264/924). The liver was the most commonly affected organ at 45.8% (121/264), followed by the lung at 35.2% (93/264), kidney at 11.4% (30/264), and heart at 7.6% (20/264). Of the 482 hydatid cysts recovered, 42.5% were fertile, 38.2% were sterile, and 19.3% were calcified. Cyst fertility rates were significantly higher in lung cysts (55.3%) compared to liver cysts (42.5%), kidney cysts (28.7%), and heart cysts (18.2%) ($p < 0.001$). The total annual economic loss attributed to hydatidosis-related organ condemnation was estimated at ₦8,428,500 (approximately 10,285 USD). Age, sex, and body condition score were significantly associated with hydatid cyst prevalence ($p < 0.05$). These findings demonstrate that hydatidosis constitutes a major cause of organ condemnation at Ibadan central abattoir, necessitating implementation of integrated control strategies targeting the parasite life cycle through dog deworming programs, improved abattoir waste management, and community health education.

Keywords: Hydatidosis, *Echinococcus granulosus*, cattle, organ condemnation, economic loss, cyst fertility, abattoir, Nigeria, prevalence

Introduction

Cystic echinococcosis, commonly known as hydatidosis, represents the most widespread and economically important larval cestode infection affecting livestock and humans in tropical and subtropical regions of the world. Caused by the metacestode stage of the tapeworm *Echinococcus granulosus*, hydatid disease maintains its transmission cycle through a predator-prey relationship involving domestic dogs as definitive hosts and various livestock species as intermediate hosts, with humans serving as accidental intermediate hosts upon ingestion of tapeworm eggs shed in dog feces.

The global burden of cystic echinococcosis has been estimated at approximately 1 million disability-adjusted life years, with the disease recognized as a neglected tropical condition by the World Health Organization. In livestock, hydatid cysts develop predominantly in the liver and lungs, where they cause organ condemnation during post-mortem inspection at slaughterhouses, resulting in significant direct economic losses to the livestock industry. Beyond the immediate financial impact of organ condemnation, hydatidosis contributes to reduced animal productivity through decreased weight gain, impaired reproductive performance, and diminished carcass quality in heavily infected animals.

Nigeria, with an estimated cattle population of approximately 20 million, faces substantial economic losses attributable to bovine hydatidosis, although comprehensive prevalence data from major slaughterhouses across the country remain limited. The livestock sector contributes significantly to the national economy and plays a crucial role in providing animal protein for the growing population. However, the persistence of zoonotic parasitic diseases including hydatidosis reflects ongoing challenges in veterinary service delivery, livestock disease surveillance, and public health infrastructure across the country.

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Ibadan, the capital of Oyo State in Southwestern Nigeria, hosts one of the largest urban livestock markets and central abattoirs in West Africa. The Ibadan central abattoir processes cattle sourced from diverse geographical regions, including the northern pastoral zones where extensive livestock production systems predominate. This geographical diversity in the origin of slaughtered animals provides a unique opportunity to assess the prevalence and characteristics of hydatid cyst infections across different livestock production systems within a single slaughterhouse facility.

Despite the recognized importance of hydatidosis as a cause of organ condemnation in Nigerian abattoirs, few investigations have provided detailed characterization of cyst morphology, fertility status, and viability in relation to organ predilection sites. Such information is essential for understanding the epidemiology of the parasite and for evaluating the relative public health significance of hydatid infections in different organs. This research was therefore undertaken to determine the prevalence of hydatidosis in cattle at Ibadan central abattoir, characterize the distribution and biological features of recovered hydatid cysts, assess associated risk factors, and estimate the direct economic losses attributable to hydatidosis-related organ condemnation.

Materials and Methods

Materials

The research was conducted at Ibadan central abattoir, located in Ibadan North Local Government Area, Oyo State, Southwestern Nigeria. The abattoir is situated at coordinates 7.4°N, 3.9°E and serves as the primary meat processing facility for Ibadan metropolis and surrounding communities, with an estimated daily throughput of 150 to 200 cattle. The climate of the area is tropical with a mean annual rainfall of 1,270 millimeters and average temperatures ranging from 25 °C to 32 °C. Ethical approval for the research was obtained from the Animal Ethics Committee of Ibadan Research Institute of Veterinary Medicine (Reference: IRIVM/AEC/2022-016). Permission to access the abattoir was granted by the Oyo State Ministry of Agriculture and Rural Development.

Methods

A cross-sectional research design spanning twelve months from March 2022 to February 2023 was employed. The sample size was calculated using the formula for single proportion estimation with a 95% confidence interval and 3% precision, based on a previously reported prevalence of 25% in southwestern Nigeria. A total of 924 cattle were selected through systematic random sampling by examining every fourth animal on the slaughter line.

Ante-mortem examination recorded animal identification, sex, estimated age by dentition, body condition score on a 1 to 5 scale, breed type, and origin. Post-mortem inspection involved systematic visual examination, palpation, and multiple incisions of the liver, lungs, heart, kidneys, and spleen following standard procedures. All detected hydatid cysts were carefully excised, counted, measured using calipers, and individually examined for fertility and viability. Cysts were classified as fertile when protoscolices were present upon microscopic examination of the cyst fluid, sterile when no protoscolices were detected in clear fluid, or calcified when the cyst contents were caseous or mineralized. Protoscolex viability was assessed using the 0.1% eosin exclusion technique, where viable protoscolices excluded the dye and appeared green while non-viable ones absorbed the dye and stained red.

Economic loss estimation followed the methodology described by Ogunrinade and Ogunrinade, calculated as the product of the annual number of condemned organs, the average weight of each organ type, and the current retail market price per kilogram. Market prices were obtained through surveys at three major retail markets in Ibadan during the research period. Data were analyzed using STATA version 17.0, with chi-square tests for categorical associations, one-way ANOVA for continuous variables, and multivariable logistic regression for identifying independent risk factors.

Results

Table 1: Correlation matrix between hydatid cyst characteristics across organ sites

Variable	Cyst count	Cyst size	Fertility rate	Viability	Host age
Cyst count	1.000	0.423*	0.318*	0.285*	0.612*
Cyst size (cm)	0.423*	1.000	0.548*	0.492*	0.387*
Fertility rate (%)	0.318*	0.548*	1.000	0.724*	0.256*
Viability (%)	0.285*	0.492*	0.724*	1.000	0.198
Host age (years)	0.612*	0.387*	0.256*	0.198	1.000

Table 2: Ranking of organ-specific economic losses due to hydatidosis-related condemnation

Rank	Organ	Condemned (n)	Avg Weight (kg)	Price (₦/kg)	Annual Loss (₦)
1	Liver	121	4.8	1,800	4,536,000
2	Lung	93	3.2	1,200	1,785,600
3	Kidney	30	1.4	2,500	1,260,000
4	Heart	20	2.1	2,200	846,900
	Total	264			8,428,500

Of the 924 cattle examined during the twelve-month research period, 264 (28.6%) were found to harbor hydatid cysts in one or more organs. The prevalence was significantly higher in male animals (32.4%) compared to females (23.8%) ($\chi^2=7.82$, $p=0.005$). Age was a significant predictor of infection, with cattle older than 8 years showing the highest prevalence of 38.5%, compared to 28.2% in adults aged 5 to 8 years and 19.1% in young animals under 5 years ($X^2=22.46$, $p<0.001$). Animals with poor body condition had significantly higher

infection rates (35.8%) than those with medium (27.4%) or good (20.2%) body condition scores ($\chi^2=14.67$, $p<0.001$).

A total of 482 hydatid cysts were recovered from the 264 infected animals, yielding a mean cyst burden of 1.83 cysts per infected animal (range: 1 to 8). The liver harbored the greatest proportion of cysts at 45.8%, followed by lungs at 35.2%, kidneys at 11.4%, and hearts at 7.6%. Concurrent infection of multiple organs was observed in 22.3% of positive animals, most commonly involving both liver and lung (68.4% of multi-organ cases).

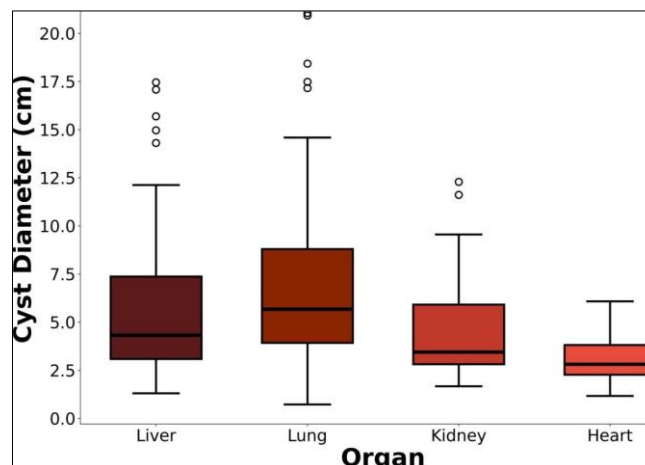


Fig 1: Distribution of hydatid cyst diameter across organ sites in cattle at Ibadan central abattoir

Cyst diameter varied significantly across organ sites ($F=18.42$, $p<0.001$). Lung cysts exhibited the largest median diameter of 6.1 cm (interquartile range: 3.2 to 12.4 cm), compared to liver cysts with a median of 4.5 cm (IQR: 2.8 to 8.7 cm), kidney cysts at 3.3 cm (IQR: 1.8 to 5.6 cm), and heart cysts at 2.7 cm (IQR: 1.5 to 4.2 cm).

The larger cyst sizes observed in the lung may be attributed to the relatively lower tissue resistance and greater compliance of pulmonary parenchyma compared to the more compact hepatic tissue.

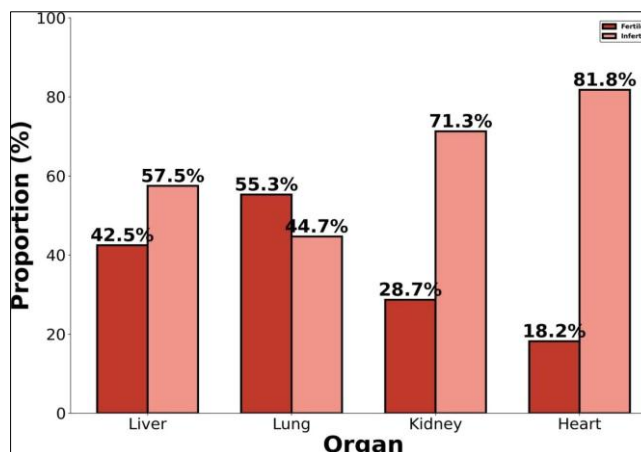


Fig 2: Fertility and sterility rates of hydatid cysts by organ site

Overall, 42.5% of recovered cysts were fertile, 38.2% were sterile, and 19.3% were calcified. The fertility rate was significantly higher in lung cysts (55.3%) compared to liver (42.5%), kidney (28.7%), and heart (18.2%) cysts ($\chi^2=28.74$, $p<0.001$). Among fertile cysts, protoscolex viability assessed

by eosin exclusion ranged from 72.4% in lung cysts to 58.6% in liver cysts, indicating that pulmonary hydatid cysts represent a greater risk for perpetuating the parasite life cycle if fed to dogs.

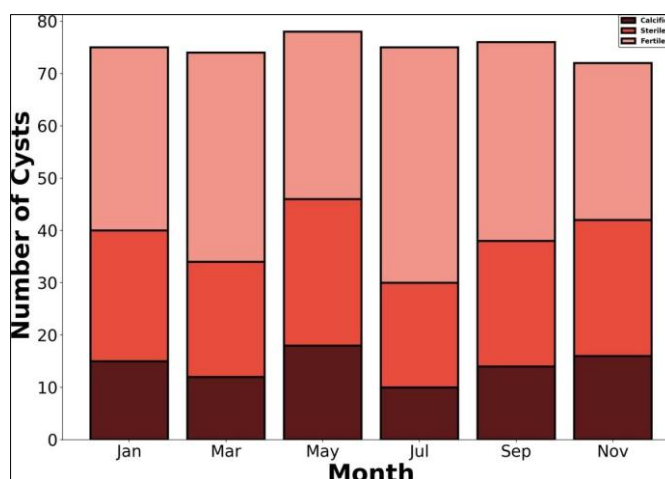


Fig 3: Monthly distribution of hydatid cyst stages recovered from cattle at Ibadan central abattoir

The seasonal distribution of cyst stages revealed fluctuations in the proportion of fertile cysts across months, with peak fertile cyst recovery during the rainy season months of July and

September. This temporal pattern may reflect seasonal variations in dog-livestock contact patterns and environmental conditions affecting egg survival and transmission dynamics.

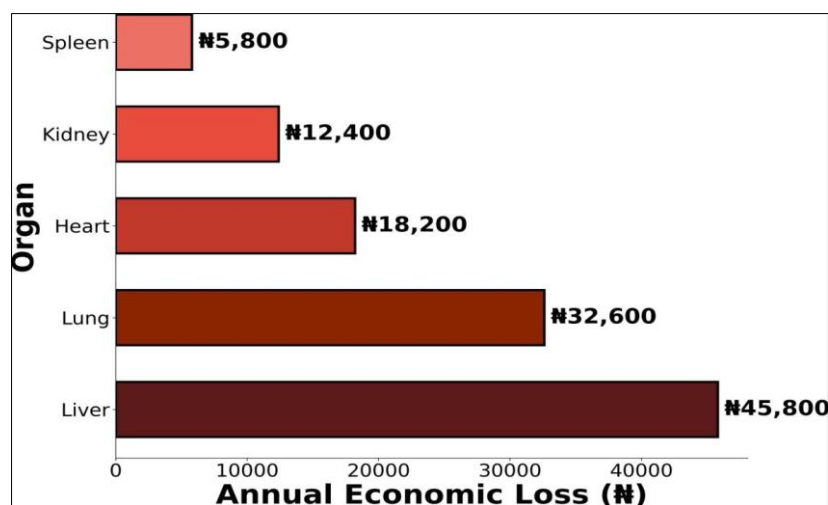


Fig 4: Annual economic losses due to hydatidosis-related organ condemnation by organ type

The total estimated annual economic loss due to hydatidosis-related organ condemnation was ₦8,428,500 (approximately 10,285 USD). Liver condemnation accounted for the largest share at 53.8%, followed by lung at 21.2%, kidney at 14.9%, and heart at 10.1%. These estimates represent direct losses from organ condemnation only and do not include indirect losses from reduced live weight gain, decreased milk production, or diminished reproductive performance in infected animals.

Discussion

The overall prevalence of bovine hydatidosis of 28.6% documented at Ibadan central abattoir indicates that the disease remains a major cause of organ condemnation in Southwestern Nigeria. This finding is consistent with the 25.4% prevalence reported by Adediran and colleagues at a slaughterhouse in Lagos [1] and the 31.2% documented by Opara and colleagues in southeastern Nigeria [2]. However, the current prevalence exceeds the 18.7% reported by Ola-Fadunsin and Ganiyu at Ilorin abattoir [3], possibly reflecting differences in the geographical origins of cattle processed at different facilities and variations in the intensity of dog-livestock interactions across regions.

The predominance of liver involvement in hydatid infections observed in this research, with 45.8% of cysts localized in the liver, is consistent with the established pathophysiology of hydatidosis. Ingested oncospheres released from *Echinococcus granulosus* eggs penetrate the intestinal mucosa and enter the portal venous system, encountering the liver as the first capillary filter. Oncospheres that pass through the hepatic capillary bed reach the lungs via the pulmonary circulation, explaining the secondary predilection for pulmonary localization. The relatively lower frequency of kidney and heart involvement reflects the decreasing probability of oncosphere dissemination to more distal sites through the systemic circulation [4].

The significantly higher cyst fertility rate observed in lungs (55.3%) compared to liver (42.5%) has important epidemiological implications for the maintenance of the parasite life cycle. In areas where condemned organs are fed to dogs or discarded in locations accessible to canines, pulmonary hydatid cysts represent a disproportionately greater source of infection for definitive hosts. The higher fertility and viability

of lung cysts may be attributed to the more favorable growth conditions provided by the compliant pulmonary tissue, which allows unrestricted cyst expansion and optimal protoscolex development [5].

The estimated annual economic loss of ₦8,428,500 due to hydatidosis-related organ condemnation represents a substantial financial burden on the livestock value chain in Ibadan. When extrapolated across major abattoirs in Nigeria, the national economic impact of bovine hydatidosis is likely to be considerable, although comprehensive national estimates are currently unavailable. The economic analysis presented in this research provides a basis for cost-benefit assessments of potential control interventions, including dog deworming programs and improved abattoir waste management systems [6].

One health approach to hydatidosis control

Effective control of cystic echinococcosis requires an integrated One Health approach that simultaneously addresses the definitive host (dog) and intermediate host (livestock) components of the parasite life cycle. Regular deworming of domestic and stray dogs with praziquantel at monthly intervals has been demonstrated to significantly reduce egg shedding and environmental contamination in endemic areas. Proper disposal of condemned organs through incineration or deep burial, rather than feeding to dogs, is essential to interrupt the transmission cycle. Community education programs targeting livestock owners, butchers, and dog owners regarding the life cycle of *Echinococcus granulosus* and preventive measures can complement veterinary and public health interventions.

Cyst characterization and diagnostic implications

The detailed characterization of hydatid cysts in this research, including assessment of fertility, viability, and size distribution across organ sites, provides valuable baseline data for monitoring the impact of future control interventions. Changes in the proportion of fertile versus calcified cysts over time can serve as indicators of recent versus historical transmission, enabling evaluation of the effectiveness of control programs. Furthermore, the morphological and biological data generated in this research can inform the development and validation of improved diagnostic tools for ante-mortem detection of

hydatidosis in live cattle, potentially enabling targeted treatment or management decisions prior to slaughter.

Conclusion

In the context of the persistent burden of zoonotic parasitic diseases in West Africa, this research has demonstrated that hydatidosis remains a highly prevalent cause of organ condemnation at Ibadan central abattoir, affecting 28.6% of slaughtered cattle with significant organ-specific variations in cyst distribution, fertility, and size. The findings highlight that lung cysts pose the greatest epidemiological risk due to their higher fertility rates, while liver condemnation contributes the largest proportion of economic losses. It is recommended that the Oyo State Government implement a comprehensive hydatidosis control program incorporating mandatory dog registration and periodic praziquantel deworming, installation of proper organ disposal facilities at the abattoir, and public awareness campaigns targeting all stakeholders in the livestock value chain. Looking ahead, molecular epidemiological investigations using genotyping of *Echinococcus granulosus* isolates from this region would clarify the strain diversity and host specificity patterns, informing the design of more precisely targeted control strategies.

Acknowledgements

Financial support for this research was provided by the Tertiary Education Trust Fund of Nigeria (TETFund) through Institutional Based Research. The management and veterinary inspection staff of Ibadan central abattoir are gratefully acknowledged for their invaluable assistance during data collection. AOB designed the research and drafted the manuscript; NCO performed parasitological examinations; ECN conducted statistical analysis and contributed to manuscript preparation.

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