P-ISSN: 2410-8863
E-ISSN:2958-6178
https://djvs.uodiyala.edu.iq
Pages: 29-38

Diyala Journal for Veterinary Sciences
Vol. 4 No.1 March (2026)
https://doi.org/10.71375/djvs.2026.04103

Prevalence and Etiology of Gross Lesions in Sheep Carcasses in Diyala Province, Iraq

Eman Abdul-Abbas Azzawi [1], Basim Mohamed Manswr [2]

Department of Pathology and Poultry Diseases, College of Veterinary Medicine, University of Diyala, Diyala, Iraq.

Corresponding Author Email Address: eman.a.a.vet@uodiyala.edu.iq

ORCID :https://orcid.org/0009-0000-4390-207X

Important dates: Received: 23-January-2026; **Accepted:** 24- March-2026; **Published**: March-2026

Abstract:

Background: Inspecting meat in butcher shops is crucial for curbing the spread of disease and protecting public health in Diyala Governorate. Lamb meat is a staple in Iraqi cuisine, and the existence of unregulated and illegal animal slaughtering practices undoubtedly contributes to public health problems and the spread of various diseases.

Aims: The study was conducted to determine the type and prevalence of gross lesions in sheep carcasses and viscera, and the economic value of such lesions at butcheries.

R**esults**: The results of the current study recorded about 84.3% of gross lesions in these carcasses, and lung and liver were most affected organs 48.2 % and 44.3% respectively. Also, the study revealed that parasitic lesion was greater than other lesions with 59.5 %, the prevalence of each of fascioliasis and hydatid cysts was 22.3 %, 16.7 % respectively. The occurrence of fascioliasis significantly ($p < 0.01$) was bigger in winter and autumn than in summer. This study also recorded pneumonia lesions (19.5%) and caseous lymphadenitis (6.3%) in the samples of the study, and all these lesions cause serious economic losses.

Conclusions: Lack of health monitoring, non-compliance with medical guidelines, and low awareness lead to the spread of many diseases and lesions that negatively affect public health and also result in serious economic losses. The control of zoonotic parasites is so powerful to eliminate these lesions and diseases, and this process requires a concerted effort from both the health and veterinary sectors.

Keyword: Sheep, Meat Inspection, Lesions, Fascioliasis, Hydatid Cyst, Zoonosis.

P-ISSN: 2410-8863
E-ISSN:2958-6178
https://djvs.uodiyala.edu.iq
Pages: 29-38

Diyala Journal for Veterinary Sciences
Vol. 4 No.1 March (2026)
https://doi.org/10.71375/djvs.2026.04103

Introduction:

In Iraq, small ruminants, especially sheep, are integral parts of livestock production and also provide income and animal protein (FAO, 2020). Sheep farming is more common in Diyala Province, due to its natural agricultural lands and the presence of the Diyala River that encourages the spread of animal herds. Nevertheless, the entire meat production chain is affected due to diseases causing pathological lesions in the carcasses and organs. These diseases also lead to loss due to carcass condemnation (Gracey et al., 2015). Recent investigations in Diyala have documented significant histopathological alterations in sheep, including hyperkeratosis, acanthosis, and neutrophilic infiltration associated with parasitic infestations, highlighting the ongoing disease burden in the province's sheep population (Awad and Kamel, 2025). Abattoirs and retail points are key points in the chain where meat is inspected, and the health of the consumer is protected. They are also the main points of surveillance to detect animal disease, many of which are zoonotic and poorly controlled (Buncic, 2006). Fascioliasis, hydatidosis, and cysticercosis are diseases of particular concern, as they are communicable and result in massive organ condemnation (Oryan et al., 2012; Mas-Coma et al., 2025).

The zoonotic risk is underscored by recent serological evidence from central Iraq, where *Toxoplasma gondii* prevalence reached 93.33% in sheep and 86.95% in goats, indicating substantial contamination of livestock with pathogens transmissible through meat consumption (Majeed and Madi, 2025). Similarly, molecular identification in Diyala Governorate has confirmed *T. gondii* infection rates of 27% in seropositive small ruminants, with significant variation by locality and age, further emphasizing the public health implications for the region (Alshaibi and Al-rubaie, 2025).

In many developing countries, Iraq included, a great deal of the slaughtering is done in the informal sector. Thus, it is the butcher shops that become the most critical and often the last point to detect unfit meat from entering to the consumer (Aalabbody, 2021). While many lesions in meat have been documented in the abattoirs in Iraq (Murtaza et al., 2017; Hassan, 2015), the role of retail butchers as critical control points is particularly significant given that viral pathogens such as foot-and-mouth disease virus (FMDV) continue to circulate. The SAT2 serotype of FMDV has been isolated in Diyala and neighboring provinces, with 35.3% of positive samples confirming this serotype, demonstrating the ongoing challenge of viral diseases that compromise animal health and carcass quality (Al-Anbagi and Allawe, 2025). A recent review of FMD in Iraq emphasizes that outbreaks occur periodically with significant economic consequences, yet management challenges persist due to inconsistent vaccine coverage and limited diagnostic capacity (Ahmed, 2025).

Even though numerous abattoir-based studies have been done in Iraq, data on meat inspection at the retail level remain scarce, particularly in Diyala, so the aim of this study will focus on demonstrating the most common lesions in sheep carcasses and economic losses in Diyala province.

P-ISSN: 2410-8863
E-ISSN:2958-6178
https://djvs.uodiyala.edu.iq
Pages: 29-38

Diyala Journal for Veterinary Sciences
Vol. 4 No.1 March (2026)
https://doi.org/10.71375/djvs.2026.04103

Materials and Methods:

Study Area:

The study targeted Diyala Province, located on the eastern side of Iraq. The province is home to more than 1.5 million people. The province's climate is arid to semi-arid and is characterized by hot, dry summers and cool, wet winters. This climate favors the development of the parasitic life cycle.

Study Design:

Sample Size and Sampling Technique :

A multistage random sampling method was employed. Five districts (Baqubah, Khalis, Muqdadiyah, Baladrooz, and Kanaan) were selected. From each district, six butcher shops were randomly chosen, resulting in 30 shops. From each shop, five sheep carcasses were inspected monthly, leading to a total sample size of 600 carcasses. Only freshly slaughtered carcasses with a complete set of offal (liver, lungs, heart and kidneys) were included.

Data Collection:

A standardized post-mortem inspection protocol was followed, adapted from the World Organization for Animal Health (WOAH) guidelines (WOAH, 2024). Each carcass was examined for lesions, bruising, and signs of systemic disease (e.g., jaundice). The viscera were meticulously inspected visually, by palpation, and by making strategic incisions. All detected lesions were described, classified, and photographed.

Lesion Classification:

Lesions were categorized based on gross pathological appearance and likely etiology:

• Parasitic Lesions: e.g., hepatic fibrosis from *Fasciola*, hydatid cysts, *Cysticercus tenuicollis*.

• Inflammatory/Infectious Lesions: e.g., pneumonia, abscesses, caseous lymphadenitis (CLA), pericarditis.

• Traumatic/Circulatory Lesions: e.g., bruising, hematomas, fractures, jaundice.

• Other Lesions: e.g., congenital defects, neoplasms.

Data Analysis:

Data were analyzed using SPSS version 26 (IBM Corp., USA), with initial entries done on Microsoft Excel. For data summaries, descriptive statistics were used (frequencies and percentages). Chi-square (χ^2) tests were conducted to determine the significance of the association of each season with the prevalence of each lesion. The threshold of statistical significance was defined as $p < 0.05$.

P-ISSN: 2410-8863
E-ISSN:2958-6178
https://djvs.uodiyala.edu.iq
Pages: 29-38

Diyala Journal for Veterinary Sciences
Vol. 4 No.1 March (2026)
https://doi.org/10.71375/djvs.2026.04103

Economic Loss Assessment

Estimations of economic losses were based on the local market prices and the average carcass prices given in the following list: 5 USD for the liver, 3 USD for the lungs, 3 USD for the heart, and 60 USD for the whole carcass.

Results:

Overall Prevalence of Lesions:

A total of 600 carcasses were inspected during this study; about 506 (84.3%) had at least one gross lesion that required partial or total condemnation, while 94 (15.7%) of the sampled carcasses did not have any gross lesions.

Organ-Specific Lesion Distribution:

These results are presented in Table (1), which shows the distribution of gross lesions in different organs. The most frequently condemned organs were the lungs and the liver.

Table (1): Distribution of gross lesions by organ in inspected sheep (N=600)

Organ	Lesion(S) Types/Disease	Number of Lesions	Prevalence (%)
Lungs	Pneumonia, Hydatid Cysts	289	48.2%
Liver	Fascioliasis, *C. tenuicollis*	266	44.3%
Carcass	Bruising, Sarcocystis	102	17.0%
Heart	Pericarditis, Hydatid Cysts	55	9.2%
Kidneys	Nephritis, Cysts	41	6.8%
Lymph Nodes	Caseous Lymphadenitis	38	6.3%
Spleen	Splenomegaly	25	4.2%

P-ISSN: 2410-8863
E-ISSN:2958-6178
https://djvs.uodiyala.edu.iq
Pages: 29-38

Diyala Journal for Veterinary Sciences
Vol. 4 No.1 March (2026)
https://doi.org/10.71375/djvs.2026.04103

Distribution of lesions by etiology:

A type of lesions was mentioned in the table (2). The cause for the lesion was parasitic lesions .

Table (2): Type of lesion and frequency of lesion in the sheep carcass.

Etiological Agent/Cause	Lesion(S) Type / Disease	Number of Lesions	Prevalence (%)
parasitic lesions:		357	59.5%
***Fasciola* Spp.**	Hepatic Fascioliasis	134	22.3%
Echinococcus Granulosus	Hydatid Cysts	100	16.7%
Taenia Hydatigena	*Cysticercus tenuicollis*	83	13.8%
Sarcocystis Spp.	*Sarcocystosis*	40	6.7%
inflammatory/infectious:			
Various Pathogens	*Pneumonia*	117	19.5%
Pyogenic Bacteria	*Abscesses*	42	7.0%
C.Pseudotuberculosis	*Caseous.Lymphadenitis (CLA)*	38	6.3%
Bacteria	*Pericarditis*	18	3.0%
	traumatic & other	71	11.8%
Trauma	*Bruising/Hematomas*	45	7.5%
Systemic Disease	*Jaundice (Icterus)*	26	4.3%

Percentages may exceed 100% as multiple lesions were recorded in individual carcasses.

Seasonal Variation:

Fascioliasis and hydatidosis were two major parasitic diseases that were recorded during the inspection of the samples of the current study; also, there was pronounced seasonal variation. .Fascioliasis was most prevalent during the cool, wet months ($p < 0.01$)

Table (3): Seasonal prevalence of major parasitic lesions

Season	Fascioliasis (N=134)	Hydatid Cysts (N=100)
Winter (Jan-Mar)	48 (35.8%)	35 (35.0%)
Spring (Apr-Jun)	22 (16.4%)	21 (21.0%)
Summer (Jul-Sep)	18 (13.4%)	14 (14.0%)
Autumn (Oct-Dec)	46 (34.3%)	30 (30.0%)
P-Value	< 0.01	< 0.05

Economic Loss Estimation

The direct financial loss due to the condemnation of organs and whole carcasses in the 600 sampled sheep is summarized in Table (4).

P-ISSN: 2410-8863
E-ISSN:2958-6178
https://djvs.uodiyala.edu.iq
Pages: 29-38

Diyala Journal for Veterinary Sciences
Vol. 4 No.1 March (2026)
https://doi.org/10.71375/djvs.2026.04103

Table (4): Estimated Economic Loss from Organ Condemnation

Cause of Condemnation	Organ/Carcass	Number Condemned	Loss (Usd)
Fascioliasis, Cirrhosis	Liver	266	1,330
Pneumonia, Hydatid Cysts	Lungs	289	867
Pericarditis, Cysts	Heart	55	165
Jaundice, Septicemia	Whole Carcass	26	1,560
Total Estimated Loss			3,922

Discussion:

The incidence of gross lesion was 84.3% in sheep meat at the retail level in Diyala Province representing a critical public health and economic concern. This rate is notably higher than the many previous studies, 76.1% and 70.5%, reported in abattoirs from Basrah (Murtaza, 2017) and Erbil (Hassan, 2015), respectively. While this discrepancy can be partly attributed to differences in inspection points where post-slaughter handling at retail markets may exacerbate or reveal conditions not as detectable immediately post-mortem the magnitude of the difference strongly suggests more fundamental underlying issues. Specifically, the higher prevalence in Diyala likely points to a breakdown in pre-slaughter control measures. This could be due to regional inadequacies in parasite control programs, biosecurity, or veterinary oversight. Critically, the prevalence may be further amplified by unregulated, off-farm slaughtering practices that bypass official veterinary inspection, allowing clinically affected animals to enter the food chain undetected, a factor that would not be captured in official abattoir data from Basrah and Erbil.

The predominance of parasitic lesions (59.5%) underscores the significant environmental and management challenges in the region. The 22.3% prevalence of fascioliasis, for instance, is a direct consequence of the local ecology, specifically the abundance of lymnaeid snails in Diyala's irrigation canals and marshes, particularly during the rainy season. This environmental factor, combined with potentially limited or poorly timed flukicide treatments, explains the peak in associated lesions during autumn and winter (Bargues et al., 2017; Al-Mayah, 2006). Similarly, the 16.7% prevalence of hydatid cysts and 13.8% prevalence of Cysticercus tenuicollis provide stark evidence of a firmly established environmental contamination cycle involving definitive canine hosts. These rates are not merely statistical findings; they are direct indicators of a gap in stray dog population control and a failure to implement effective deworming programs for farm dogs. This creates a substantial zoonotic risk, as cystic echinococcosis in humans can lead to life-threatening complications (Eckert and Deplazes, 2004).

P-ISSN: 2410-8863
E-ISSN:2958-6178
https://djvs.uodiyala.edu.iq
Pages: 29-38

Diyala Journal for Veterinary Sciences
Vol. 4 No.1 March (2026)
https://doi.org/10.71375/djvs.2026.04103

The high prevalence of pneumonia (19.5%) among inflammatory conditions is a clear indication of poor welfare and management practices. It points to intensive stress factors in the production chain, such as overcrowding, transport over long distances, and inadequate ventilation in holding pens (Radostits et al., 2007). Caseous lymphadenitis (CLA) is not as common as other diseases, but it is still important because it is chronic and contagious, and it can directly affect the economy by causing weight loss and the condemnation of affected carcass parts, which can ruin meat that could otherwise be sold (Fontaine and Baird, 2008).

The economic ramifications of these pathological findings are severe and extend beyond the immediate loss for butchers. The direct financial loss of nearly 4,000 USD from just 600 sheep extrapolates to a staggering annual loss for the province, representing a direct drain on the income of farmers and butchers. This loss is compounded by the fact that condemned meat represents a wasted protein source in the local food economy. However, the true economic cost is even greater when considering the role of unregulated slaughter. Animals with these lesions, especially those with long-term problems like hydatid cysts or fascioliasis, are often in worse shape, which means their carcasses weigh less and are worth less even before they are inspected. If these animals are diverted to unregulated channels to avoid condemnation, they are sold at a lower price, undercutting legal markets and evading taxes, while simultaneously sustaining the disease cycle and posing a direct health risk to consumers. Therefore, the higher prevalence observed in Diyala is likely a direct function of this combination: weak on-farm disease control and a potentially larger, unmonitored slaughter sector that allows diseased animals to be processed without the economic penalty of carcass condemnation, thereby perpetuating the cycle of infection.

Conclusions:

This study concluded that fascioliasis and hydatid cysts pose a two-fold relative threat. Organ condemnation leads to an immediate economic loss, and the threat to humans is persistent. There is a need to support on-farm disease surveillance and support integrated into reinforced veterinary services. Infected meat and organs must be kept out of the food chain, and the last control point must be effective, which means thorough and complete meat inspection. Fascioliasis is seasonal, and controlling the parasite populations regionally, coordinated targeted deworming, and snail control are warranted. Zoonotic disease cycles must be broken through veterinary, medical, and environmental collaboration, which includes implementing vaccination programs, improving sanitation practices, and enhancing public awareness about zoonotic diseases.

P-ISSN: 2410-8863
E-ISSN:2958-6178
https://djvs.uodiyala.edu.iq
Pages: 29-38

Diyala Journal for Veterinary Sciences
Vol. 4 No.1 March (2026)
https://doi.org/10.71375/djvs.2026.04103

Recommendations:

-Enhanced Veterinary Services: The Diyala Veterinary Directorate needs to start post-mortem inspection at every slaughter point and informal butcher shop and offer these services to the general public.
-Integrated Parasite Control: Develop public health.
-Better Husbandry Practices: Improvement of animal handling, transport, and housing.
-More Research: Understanding the epidemiology and zoonotic potential of E. granulosus and Fasciola species.

Acknowledgment:

The authors thank the butchers and shop owners in Diyala Province for their cooperation during the data collection process.

Conflict of Interest:

The authors declare no conflict of interest.

Funding Sources:
The study did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Authors Contributions:

Both of authors contributed equally to the conception, design, data collection, analysis, and writing of the manuscript.

References:

FAO. (2020). *FAOSTAT: Livestock Primary*. Food and Agriculture Organization of the United.Nations. Rome. https://www.feedipedia.org/node/26356 .

Gracey, J. F., Collins, D. S., & Huey, R. J. (2015). *Meat Hygiene* (11th ed.). W.B..Saunders..DOI:10.1002/9781118649985.

Collins, D. S., & Huey, R. J. (Eds.). (2015). *Gracey's meat hygiene*. John Wiley & Sons.

Awad, A. K., & Kamil, G. S. (2025). Histopathological Investigation of Sarcoptes scabiei Infestation in Sheep Population in Diyala Province, Iraq. Iranian Journal of Veterinary Medicine, 19(4). DOI:10.32598/ijvm.19.4.1005548

Buncic, S. (2006). *Integrated Food Safety and Veterinary Public Health*. CABI Publishing.

Oryan, A., Goorgipour, S., Moazeni, M., & Shirian, S. (2012). Abattoir prevalence, organ distribution, and public health significance of major parasitic infections of sheep and goats in Iran. *Tropical Animal Health and Production*, 44(1), 155-161. https://www.researchgate.net/publication/231224748.

P-ISSN: 2410-8863
E-ISSN:2958-6178
https://djvs.uodiyala.edu.iq
Pages: 29-38

Diyala Journal for Veterinary Sciences
Vol. 4 No.1 March (2026)
https://doi.org/10.71375/djvs.2026.04103

Mas-Coma, S., Cuervo, P. F., Chetri, P. B., Tripathi, T., Gabrielli, A. F., & Bargues, M. D. (2025). Emerging human Fascioliasis in India: review of case reports, climate change impact, and geo-historical correlation defining areas and seasons of high infection risk. Tropical Medicine and Infectious Disease, 10(5), 123. https://doi.org/10.3390/tropicalmed10050123

Majeed, S. A., & Madi, E. H. (2025). Seroprevalence of toxoplasmosis in sheep, goat, cattle, and buffaloes in Baghdad, Iraq. Open Veterinary Journal, 15(9), 4412-4417. doi:10.5455/OVJ. 2025.v15.i9.48.

Alshaibi, M. Z., Al-Rubaie, H., Al-Araby, M., Abbas, I., & El-Alfy, E. S. (2025). Seroprevalence and Molecular Identification of Toxoplasma gondii Infecting Small Ruminants in Diyala Governorate, Iraq. Alexandria Journal of Veterinary Sciences, 87p32. doi:10.5455/ajvs.284136.

Aalabbody, H. H. (2021). A comparative study of the consumer's attitude on the meat hygiene slaughtered in and outside the slaughter housees: a comparative study of the consumers attitude on the meat hygiene slaughtered in and outside the slaughter housees. *Iraqi Journal of Market Research and Consumer Protection*, *13*(1), 77-84. DOI: http://dx.doi.org/10.28936/jmracpc13.1.2021.

Murtaza, M., Al-Azizz, S. A., Abdulhameed, F. M., & Kadhim, L. (2017). Active survey of hydatid cysts in slaughtered sheep at Basrah abattoirs, Basrah province, Iraq. *Journal of Entomology and Zoology Studies*, *5*(5), 951-954. https://www.researchgate.net/publication/ 320086410.

Hassan, N. O. (2015). Prevalence of some infections in liver and lung of slaughtered ruminants in Koya abattoir, Erbil, Iraq. *Tikrit J. Pure Sci*, *20*(2), 1-6. https://doi.org/10.25130/tjps.v20i2.1150

AL-Anbagi, G. K., & Allawe, A. B. (2025). Isolation of SAT2 foot and mouth disease virus in Iraq. *The Iraqi Journal of Veterinary Medicine*, *49*(1), 16-22. doi:10.30539/pnc4zf32.

Al-Qaisi, A.F. (2025). Prevalence and Management of Foot-and-Mouth Disease in Cattle in Iraq: A Short Review, in Proceedings of the 1st International Online Conference on Veterinary Sciences, 3–5, MDPI: Basel, Switzerland, doi:

World Organisation for Animal Health (WOAH). (2024). Control of biological hazards of animal health and public health importance through ante- and post-mortem meat inspection (Chapter 6.3.). In Terrestrial Animal Health Code. https://www.woah.org/fileadmin/Home/eng/Health_standards/tahc/2024/en_chapitre_control_bio_hazard.htm

Bargues, M. D., Gayo, V., Sanchis, J., Artigas, P., Khoubbane, M., Birriel, S., & Mas-Coma, S. (2017). DNA multigene characterization of Fasciola hepatica and Lymnaea neotropica and its fascioliasis transmission capacity in Uruguay, with historical correlation, human report review and infection risk analysis. PLoS Neglected Tropical Diseases, 11(2), 1-33. https://doi.org/10.1371/journal.pntd.0005352 .

P-ISSN: 2410-8863
E-ISSN:2958-6178
https://djvs.uodiyala.edu.iq
Pages: 29-38

Diyala Journal for Veterinary Sciences
Vol. 4 No.1 March (2026)
https://doi.org/10.71375/djvs.2026.04103

Al-Mayah, S. H. (2006). The epizootiology of ruminant fascioliasis in Basrah province., AL-Qadisiyah Journal of Veterinary Medicine Sciences,5(1), 38-46. https://www.researchgate.net/profile/Sabeeh-Al-Mayah.

Eckert, J.& Deplazes, P. (2004). Biological, epidemiological, and clinical aspects of echinococcosis, a zoonosis of increasing concern. *Clinical Microbiology Reviews*, 17(1), 107-135. DOI: 10.1128/CMR.17.1.107-135.2004

Radostits, O. M., Gay, C. C., Hinchcliff, K. W., & Constable, P. D. (2007). *Veterinary Medicine: A Textbook of the Diseases of Cattle, Horses, Sheep, Pigs, and Goats* (10th ed.). Elsevier. https://books.google.iq/books.

Fontaine, M. C., & Baird, G. J. (2008). Caseous lymphadenitis. *Small Ruminant Research*, 76(1-2), 42-48. https://doi.org/10.1016/j.smallrumres.