



Abattoir Surveillance of Meat Inspection Findings in Sheep and Goats: A Three-Year Study (2023–2026) in Qazvin, Iran

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ABSTRACT

Introduction: Abattoir inspection records provide valuable information on animal health and pathological conditions in food animals and can reveal seasonal patterns in slaughter activity and carcass condemnation. This study assessed meat quality parameters and post-mortem meat inspection findings in sheep and goats slaughtered in Qazvin, Iran, over a three-year period.

Methods: Data were obtained from routine meat inspection records at a slaughterhouse in Qazvin from 21 March 2023 to 20 March 2026 (1402–1404 in the Iranian calendar). Total slaughter weight, proportion of condemned weight, and frequency of major pathological findings were evaluated. Data were summarized by season and year using totals and percentages, and statistical comparisons were performed between species.

Results: Sheep accounted for most of the slaughter weight throughout the study period. Annual slaughter weights for sheep were 1,060,496, 757,255, and 821,633 kg, compared with 131,104, 79,609, and 80,342 kg for goats. Seasonal variation was observed in both species, with generally higher slaughter weights in summer and autumn. The proportion of condemned weight also varied across seasons, with higher values in spring for sheep and in summer for goats in some years. In sheep, the most frequent pathological findings were infectious diseases, jaundice, sarcocystosis, cachexia, and cysticercosis, whereas goat findings were less frequent and mainly included infectious diseases, cachexia, and sarcocystosis. The overall distribution of pathological categories differed significantly between sheep and goats ($\chi^2 = 13.295$, $p = 0.039$).

Conclusion: These findings highlight the value of routine abattoir surveillance for monitoring seasonal slaughter patterns and post-mortem meat inspection findings in small ruminants in Qazvin.

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Introduction

Ensuring the safety of food especially animal derived food remains a central component of public health systems worldwide. Meat inspection at slaughterhouses is a key part of food safety systems and helps identify carcass lesions and condemnation causes that may compromise the safety and quality of meat entering the food chain. In addition to its role in food safety, abattoir inspection provides valuable information about the health status of livestock populations and the occurrence of infectious, parasitic, and metabolic disorders. Data obtained during routine slaughter

inspection also provide a valuable record of total animal health conditions observed at the population level and can offer insights into disease patterns affecting food producing livestock (1). Sheep and goats represent an important part of livestock production in many regions of the world, including the Middle East (2). In Iran, small ruminants are widely raised in rural areas for meat production purpose, particularly in semi-arid and mountainous regions where the rearing of other livestock species is more limited (3). These animals can present diverse meat inspection findings and diseases that may affect

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carcass quality, reduce productivity, and in some cases pose zoonotic concerns. During routine post mortem inspection, lesions related to parasitic infections, systemic diseases, nutritional disorders, and chronic infectious conditions are frequently observed. Recording and analyzing these findings through abattoir surveillance allows a better understanding of the health challenges affecting livestock populations (4).

Slaughterhouse based surveillance has long been recognized as a useful approach for monitoring animal diseases because abattoirs receive animals from multiple farms and management systems. As a result, inspection records may reflect broader regional trends in animal health. These data can also reveal seasonal variations in disease occurrence, which may be influenced by climatic conditions, feeding practices, animal movement, and management factors. Observing such patterns can contribute to improved disease prevention strategies and more targeted veterinary interventions (5).

In Iran, meat inspection is carried out under the supervision of the Iran Veterinary Organization as part of the national system for food safety and disease control. Routine inspection programs provide an important layer of protection for consumers and generate valuable records of pathological findings in slaughtered animals (6). Although several studies and surveillance reports have documented specific diseases (7-9), broader evaluations that examine meat quality alongside meat inspection findings over extended periods remain relatively limited for some areas.

Qazvin Province is an important livestock producing region located in northern central Iran. Its geographical position and active livestock trade contribute to a steady flow of animals to local slaughter facilities. In some regions, seasonal climatic variation may contribute to differences in animal health and disease occurrence (10). Information derived from abattoir records in this region can therefore offer useful insight into both livestock health and meat inspection outcomes within a significant production area.

An examination of slaughterhouse data across multiple seasons and years can provide a clearer picture of trends in carcass inspection findings and overall slaughter performance. Such information may support veterinary authorities in monitoring disease occurrence and identifying patterns that warrant further investigation. It may also contribute to improving management practices aimed at safeguarding meat quality and public health (11,12).

The present study was conducted to analyze slaughterhouse inspection data from sheep and goats slaughtered in Qazvin, Iran, over a three-

year period from March 2023 to March 2026 (1402 to 1404 in the Iranian calendar). The study aimed to describe patterns observed in slaughter records and pathological findings detected during routine meat inspection across different seasons in this region. Findings from this work may contribute to a clearer understanding of disease occurrence in small ruminants and provide useful reference information for veterinary public health monitoring and livestock health management in the area.

Material and Method

Study Design and Study Area

This study used routine meat inspection records from Dasht-e Bareh Slaughterhouse in Qazvin Province, Iran, which operates under the supervision of the Qazvin Veterinary Organization. The investigation followed a retrospective longitudinal (repeated cross-sectional) approach based on abattoir inspection data from sheep and goats processed for human consumption. These small ruminants represent an important share of the animals slaughtered for meat production in the region.

Study Period

The study covered three years from 21 March 2023 to 20 March 2026 (according to the Iranian calendar, years 1402 to 1404). This duration consisted of three annual cycles: 21 March 2023 to 19 March 2024 (Solar Hijri 1402), 20 March 2024 to 20 March 2025 (Solar Hijri 1403), and 21 March 2025 to 20 March 2026 (Solar Hijri 1404). For each year, data were categorized by season to compare trends across the four seasons.

Data Sources and Meat Inspection Procedures

Data were obtained from official slaughterhouse records collected during routine veterinary inspection of sheep and goats. Examination of carcasses and internal organs after slaughter was performed by authorized veterinary inspectors.

The inspection procedures followed standard meat inspection principles described in veterinary public health guidelines (13-15). The process included visual examination, palpation, and incision of carcasses and organs to identify pathological changes. When signs of disease or other abnormalities were detected, the affected carcasses or organs were condemned according to regulatory requirements, and the weights of these condemned parts were recorded in the official slaughterhouse documentation.

Classification of Recorded Diseases and Pathological Disorders

The findings recorded during meat inspection were grouped into the main categories used in this study, including cysticercosis, sarcocystosis,

jaundice, symptomatic anthrax, tuberculosis, cachexia, infectious diseases, and miscellaneous disorders. This classification was based on the diagnoses and descriptions documented in the official slaughterhouse records. The category infectious diseases was used for cases diagnosed during routine meat inspection as infectious in nature, based on gross ante mortem and post mortem findings consistent with systemic infection. However, this category did not distinguish specific etiological agents or individual infectious disease entities. In most cases, this category referred to conditions associated with breakdown of normal body defenses and marked febrile reactions in the carcass, and it mainly included diseases such as foot and mouth disease (FMD), peste des petits ruminants (PPR), and peracute pneumonia. The category miscellaneous disorders included findings that could not be clearly assigned to the other predefined categories, such as localized abscesses, bruising, hematoma, adhesions, and other non-specific localized abnormalities.

Slaughter and Meat Production Data

Total slaughter weight (kg) for both sheep and goats processed at the abattoir was extracted from inspection records for each season across the study period. This data characterized the overall volume of slaughtered animals and seasonal patterns in meat production.

Statistical Analysis

Descriptive statistics were used to summarize slaughter records and pathological findings in sheep and goats across the study period. Total slaughter weight and condemned weight were aggregated by species, year, and season. Condemned weight was expressed as a percentage of total slaughter weight for each species and season, calculated by dividing the condemned weight by the total slaughter weight and multiplying by 100.

Mean total slaughter weight and mean condemnation percentage were compared between sheep and goats using Welch's t-test, which was selected because it does not assume equal variances between groups.

For pathological findings, the frequencies of each category were summarized by species, year, and season. For graphical presentation, these frequencies were converted to percentages within each season. However, statistical comparisons were based on the original count data rather than the derived percentages. Differences in the overall distribution of pathological categories between

sheep and goats were assessed using a chi-square test of independence. Because some categories occurred very infrequently and resulted in sparse expected cell frequencies, symptomatic anthrax, pox, and tuberculosis were combined into a single category designated as rare conditions before analysis.

All tests were two-sided, and statistical significance was defined as $p < 0.05$. Owing to the low frequency of some pathological categories, the chi-square results were interpreted cautiously as reflecting an overall pattern of distribution rather than conclusive species-specific differences across all categories. Data analysis was conducted using IBM SPSS Statistics, version 25.0 (IBM Corp., Armonk, NY, USA).

Results

Total Slaughter Weight

Overall, sheep contributed substantially more to total slaughter weight than goats. Across all seasonal observations, the mean slaughter weight was 1,297,183 kg for sheep and 180,563 kg for goats, and this difference was statistically significant (Welch's t-test, $t = 15.917$, $p < 0.001$). In sheep (Figure 1a), slaughter weight was generally higher in summer and autumn and lower in winter. In 2023–2024 (1402), the highest value was recorded in summer (1,763,624 kg) and the lowest in winter (1,066,342 kg). In 2024–2025 (1403), autumn showed the highest slaughter weight (1,560,303 kg), whereas spring recorded the lowest (915,258 kg). In 2025–2026 (1404), summer again had the highest value (1,485,096 kg), while winter had the lowest (706,864 kg). Despite these numerical differences, seasonal variation was not statistically significant across the three year period ($p > 0.05$).

In goats (Figure 1b), a similar but less pronounced variation was observed. In 2023–2024 (1402), autumn showed the highest slaughter weight (193,679 kg), whereas spring had the lowest (129,184 kg). In 2024–2025 (1403), the highest value was again observed in autumn (275,965 kg), while winter recorded the lowest (189,225 kg). In 2025–2026 (1404), summer showed the highest slaughter weight (241,031 kg), and winter the lowest (126,679 kg). However, seasonal differences in goats were also not statistically significant over the study period ($p > 0.05$).

Overall, sheep consistently represented the major share of slaughter weight in the abattoir, and both species tended to show greater slaughter activity during summer and autumn than during winter.



Figure 1. Total slaughter weight (kg) recorded during meat inspection across the four seasons from 2023 to 2026 in Qazvin, Iran: (a) sheep and (b) goats. An average carcass weight of 16 kg was considered equivalent to one slaughtered sheep or goat.

Percentage of Condemned Weight Relative to Total Slaughter Weight

The percentage of condemned weight relative to total slaughter weight showed seasonal and annual variation in both sheep and goats (Figure 2). When all seasonal observations were considered together, the mean condemnation percentage was significantly higher in sheep (0.288%) than in goats (0.178%) according to Welch's t-test ($t = 2.457$, $p = 0.024$).

In sheep (Figure 2a), condemnation percentages fluctuated across the study period. In 2023–2024 (1402), the lowest value was recorded in winter (0.17%) and the highest in spring (0.47%). During 2024–2025 (1403), seasonal values were comparatively stable, ranging from 0.18% to 0.26%. In 2025–2026 (1404), higher percentages were again observed in spring (0.41%) and summer (0.34%), while autumn and winter both recorded 0.29%. However, seasonal differences

in sheep were not statistically significant over the three year period ($p > 0.05$).

In goats (Figure 2b), condemnation percentages also varied across seasons and years. In 2023–2024 (1402), values ranged from 0.04% in autumn to 0.24% in spring. In 2024–2025 (1403), the highest value occurred in summer (0.33%), whereas the other seasons ranged from 0.08% to 0.25%. In 2025–2026 (1404), summer showed the highest condemnation percentage (0.54%), while the remaining seasons were notably lower, between 0.08% and 0.14%. Despite these variations, no statistically significant seasonal effect was detected in goats across the study period ($p > 0.05$).

Overall, condemned weight accounted for a very small proportion of total slaughter weight in both species, but the higher average percentage in sheep indicates that condemnation was relatively more frequent in sheep than in goats.

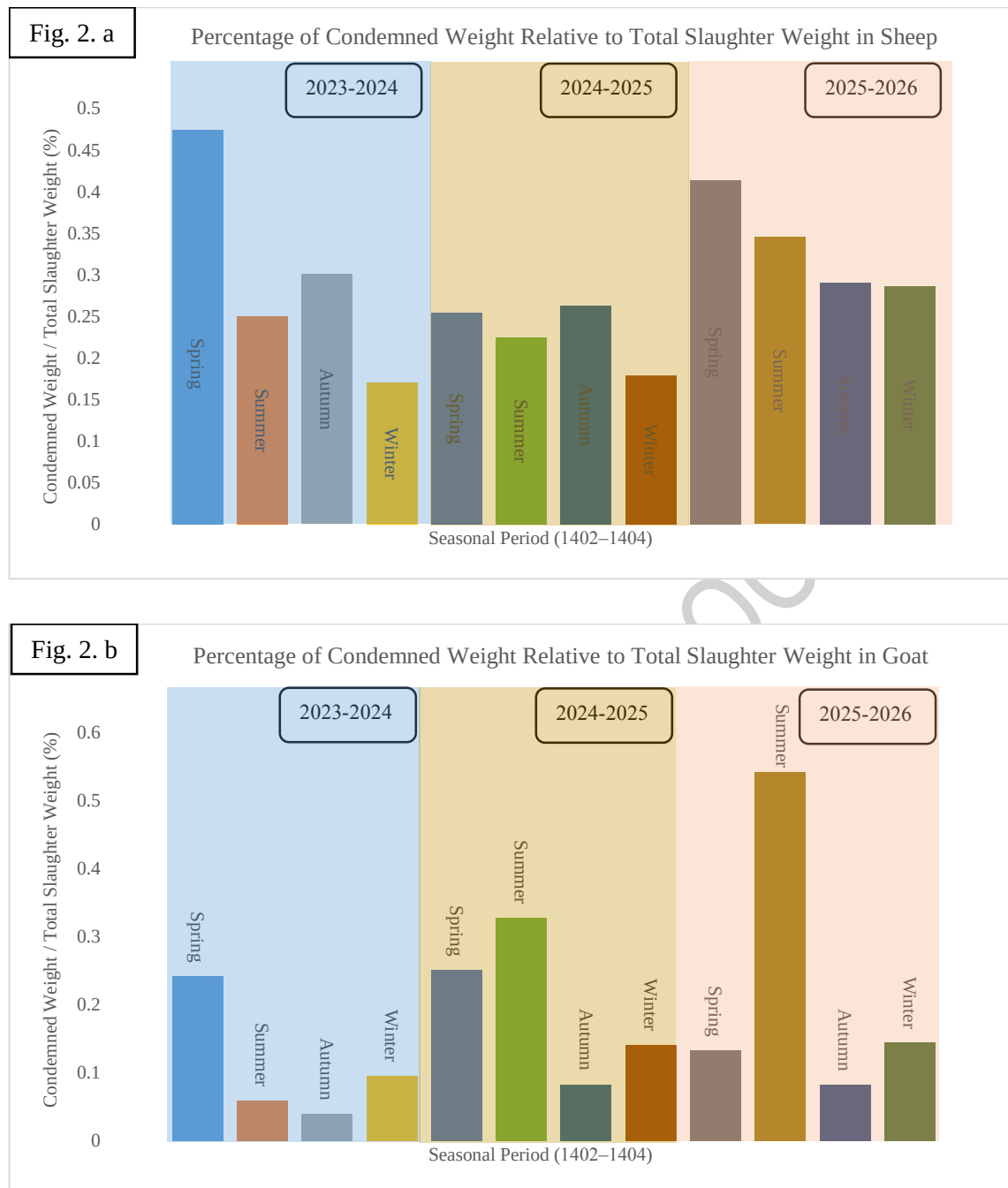


Figure 2. Percentage of condemned weight relative to total slaughter weight recorded during meat inspection across the four seasons from 2023 to 2026 in Qazvin, Iran: (a) sheep and (b) goats.

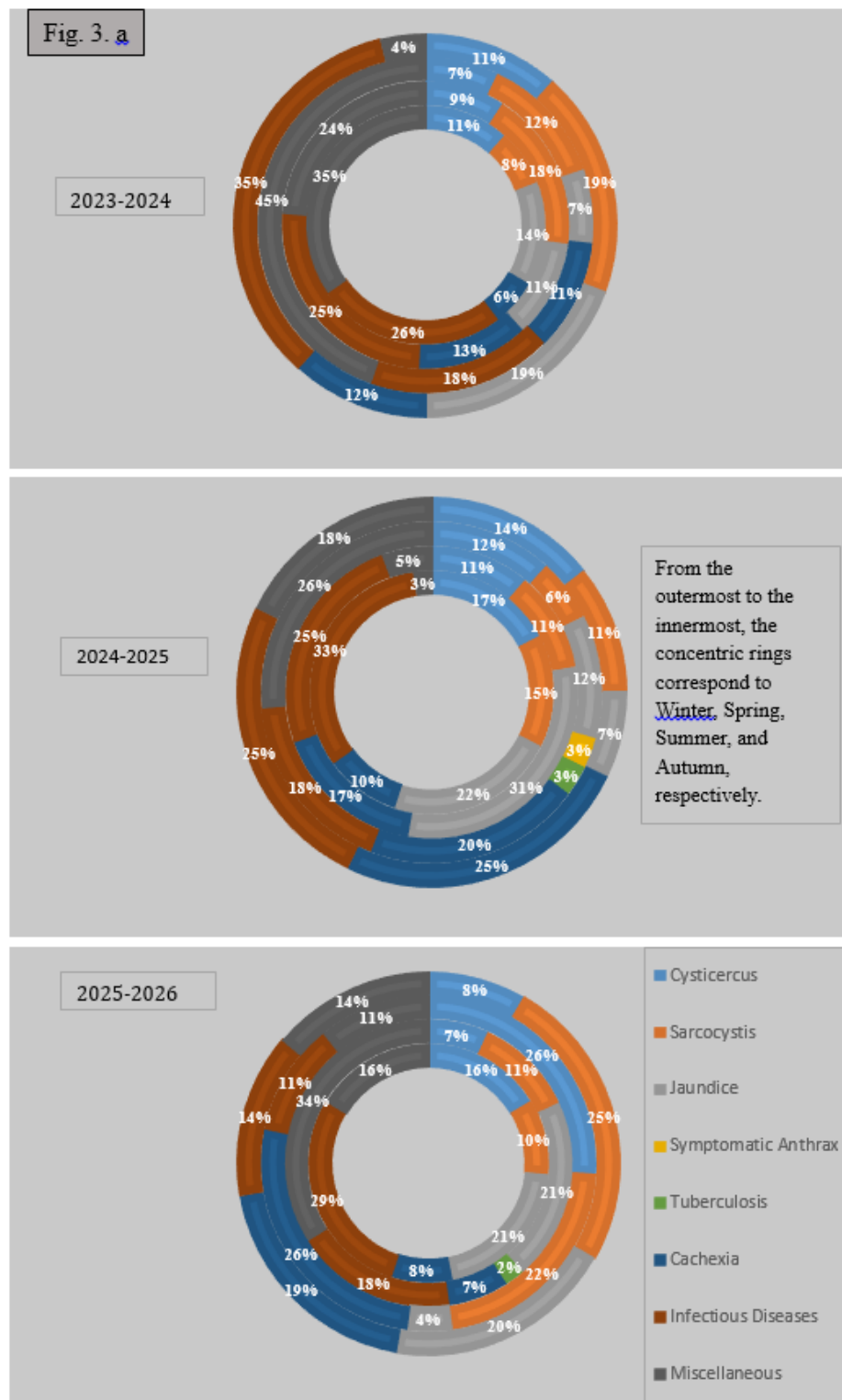
Pathological Findings during Meat Inspection

A variety of pathological conditions were identified during post mortem inspection of slaughtered animals. The distribution of these findings across seasons and years is presented in Figure 3. To complement Figure 3, the absolute frequencies of meat inspection findings stratified by study year and season are presented separately for sheep and goats in Tables 1 and 2. For sheep, the seasonal distribution of meat inspection findings is shown in Figure 3(a). Across the entire study period, a total of 528

cases were recorded. The most frequently identified categories were infectious diseases (22.7%) and miscellaneous conditions (22.0%), followed by jaundice (15.2%), sarcocystosis (13.6%), cachexia (13.4%), and cysticercosis (12.5%). In 2023–2024 (1402), miscellaneous conditions and infectious disease lesions were commonly recorded, particularly during spring and autumn. Cysticercosis and sarcocystosis were also detected across several seasons, whereas jaundice occurred sporadically. In 2024–2025 (1403), a broadly similar variation

was observed, with continued detection of parasitic infections and occasional cases of jaundice and cachexia. In 2025–2026 (1404), cysticercosis cases became more prominent in spring and autumn, while miscellaneous lesions

remained consistently reported across multiple seasons. Only isolated cases of symptomatic anthrax and tuberculosis were detected during the entire study period.



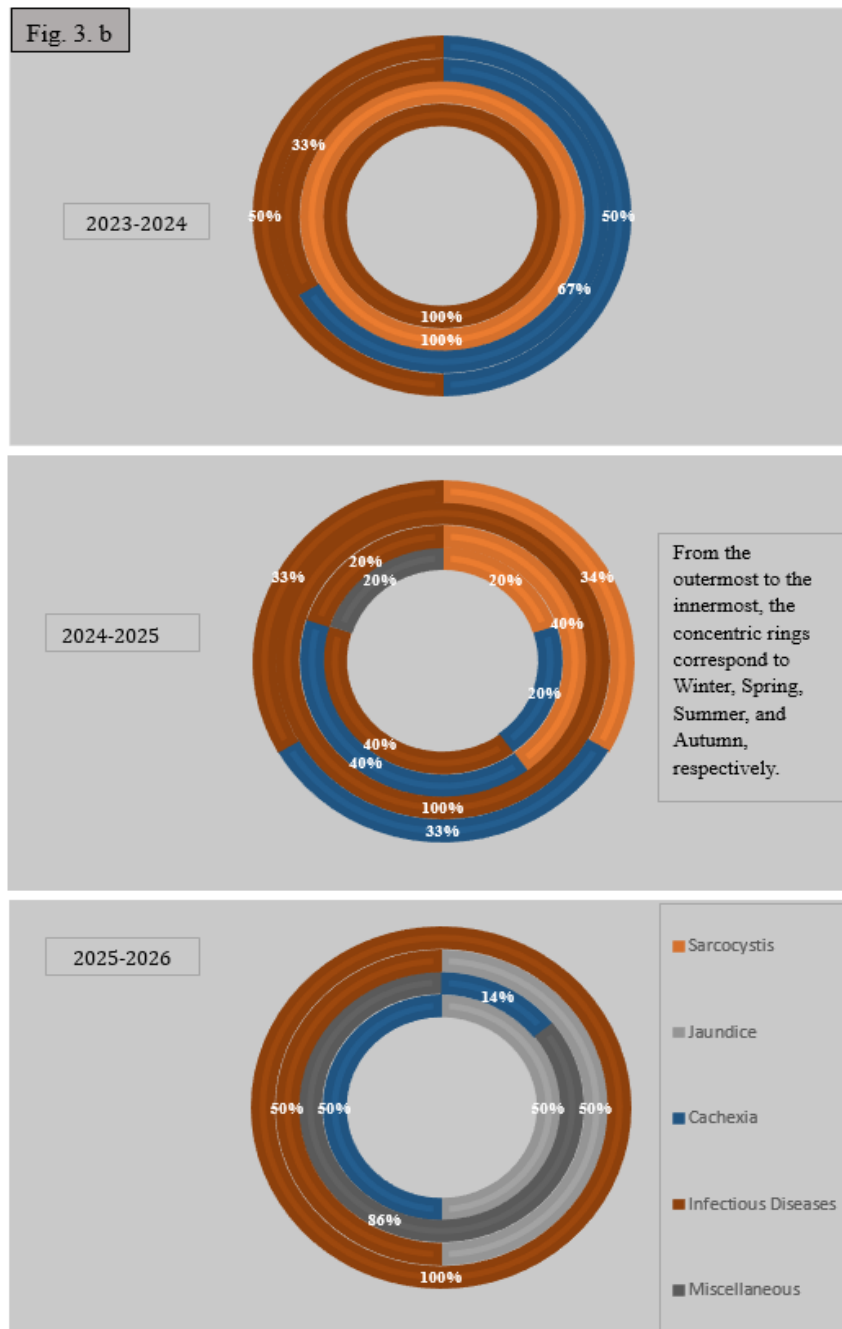


Figure 3. Seasonal distribution of meat inspection findings in slaughtered animals during meat inspection at the abattoir (2023–2026, Qazvin, Iran): (a) sheep and (b) goats. Percentages are calculated within each season.

Table 1. Absolute frequencies of meat inspection findings in sheep by study year and season during routine meat inspection in Qazvin, Iran.

Meat inspection finding	2023-2024				2024-2025				2025-2026			
	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter
Cysticercosis	9	5	4	3	7	4	4	4	8	3	12	3
Sarcocystosis	6	10	7	5	6	4	2	3	5	5	10	9
Jaundice	11	6	4	5	9	11	4	2	10	9	2	7
Symptomatic anthrax	0	0	0	0	0	0	1	0	0	0	0	0
Pox	0	0	0	0	0	0	0	0	0	0	0	0
Tuberculosis	0	0	0	0	0	0	1	0	0	1	0	0
Cachexia	5	7	6	3	4	6	7	7	4	3	12	7
Infectious diseases	20	14	10	9	13	9	6	7	14	8	5	5
Miscellaneous disorders	27	13	25	1	1	2	9	5	8	15	5	5

Table 2. Absolute frequencies of meat inspection findings in goat by study year and season during routine meat inspection in Qazvin, Iran.

Meat inspection finding	2023-2024				2024-2025				2025-2026			
	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter
Cysticercosis	0	0	0	0	0	0	0	0	0	0	0	0
Sarcocystosis	0	2	0	0	1	2	0	1	0	0	0	0
Jaundice	0	0	0	0	0	0	0	0	1	0	1	0
Symptomatic anthrax	0	0	0	0	0	0	0	0	0	0	0	0
Pox	0	0	0	0	0	0	0	0	0	0	0	0
Tuberculosis	0	0	0	0	0	0	0	0	0	0	0	0
Cachexia	0	0	2	1	1	2	0	1	1	1	0	0
Infectious diseases	3	0	1	1	2	1	2	1	0	0	1	2
Miscellaneous disorders	0	0	0	0	1	0	0	0	0	6	0	0

The seasonal distribution of meat inspection findings in goats is illustrated in Figure 3(b). Overall, the total number of cases in goats was markedly lower than in sheep, with only 38 recorded during the study period. Infectious diseases represented the largest proportion of findings (36.8%), followed by cachexia (23.7%), miscellaneous conditions (18.4%), sarcocystosis (15.8%), and jaundice (5.3%). In 2023-2024 (1402), only a small number of infectious disease cases were reported. In 2024-2025 (1403), occasional cases of sarcocystosis and cachexia were observed. During 2025-2026 (1404), pathological findings remained limited, although several miscellaneous lesions were recorded in summer. No cases of cysticercosis, symptomatic anthrax, tuberculosis, or pox were identified in goats throughout the study period.

After combining rare categories for statistical analysis, the overall distribution of pathological findings differed significantly between sheep and goats ($\chi^2 = 13.295$, $df = 6$, $p = 0.039$). However, given the low frequency of some categories and the small expected counts in several cells, this difference is better regarded as an overall tendency in the distribution pattern rather than definitive evidence of species-specific differences across all pathological categories.

Discussion

The present study identified seasonal differences in the recorded slaughter weight of sheep and goats in Qazvin during the study period. In the descriptive data, slaughter weights for both species were generally greater in summer and autumn and lower in winter. These observations may reflect seasonal changes in animal availability, market demand, and animal movement (16). Comparable seasonal fluctuations in slaughter activity have also been described in abattoir-based studies from other regions, where climatic conditions and livestock trading practices were considered relevant

influences on slaughter volumes throughout the year (17-20).

In this study, sheep accounted for most of the slaughter weight, condemned weight, and pathological findings compared to goats. This observation may be related to the larger sheep population in the region and their greater contribution to local meat production. Goats showed consistently lower slaughter weights and fewer pathological findings throughout the study period. Differences in management practices, feeding systems, and animal sourcing between species may partly explain these variations (21,22).

The recorded proportion of condemned weight differed across seasons and years in both species. Relatively higher condemnation proportions were recorded in some seasons, which may reflect fluctuations in pre-slaughter animal health status as well as variation in the frequency of detectable lesions during meat inspection (23). Condemnation of affected tissues remains an important component of meat hygiene control because it helps prevent the distribution of unsuitable meat for human consumption and also provides indirect information on disease occurrence in livestock populations (24).

Among the recorded findings, parasitic conditions such as cysticercosis and sarcocystosis were frequently observed in sheep. These findings may be of economic importance because of their association with organ or carcass condemnation, while their public health relevance depends on the specific parasite species involved (25). Their continued presence may indicate persistent exposure to parasitic contamination in grazing environments or insufficient control measures at the farm level (26). Infectious disorders and miscellaneous lesions were also commonly detected during inspection. Conversely, during the entire study period, one inspection-based finding compatible with symptomatic anthrax and two findings compatible with tuberculosis were recorded in

sheep, with no cases observed in goats. Given their extremely low frequencies, these isolated and occasional findings should be interpreted cautiously and do not necessarily indicate active epidemiological occurrence in the wider population.

Routine slaughterhouse surveillance provides valuable field information that may not always be captured through farm investigations alone (5). The findings of this study support the practical value of continuous meat inspection as a useful source of field information on animal health status and recorded pathological conditions. However, the results should be interpreted in light of several limitations. The study was based on records from a single slaughterhouse in Qazvin, which may limit the applicability of the findings to other regions or production settings. In addition, laboratory confirmation was not available for all detected conditions, and the results therefore reflect observations made during routine meat inspection rather than definitive diagnoses. The relatively small number of findings recorded in goats should also be considered when comparing the two species. Future studies involving multiple slaughterhouses, broader geographic coverage, and complementary laboratory investigations may provide a more comprehensive understanding of disease distribution in small ruminants in Iran.

Conclusion

This study showed that sheep accounted for a greater share of slaughter weight, condemned weight, and recorded pathological findings than goats in the Qazvin abattoir. The most frequent findings in sheep were infectious disorders, miscellaneous lesions, jaundice, sarcocystosis, cachexia, and cysticercosis, whereas goats showed fewer overall findings, with infectious disorders and cachexia being the most common. Descriptive differences in slaughter weight and condemnation proportions were observed across seasons in both species. Overall, these results support the value of routine meat inspection as a practical source of field information for monitoring animal health status and recorded pathological findings in small ruminants.

Declarations

Funding

None.

Authorship Contribution

A. F.: investigation, data curation. **R. Kh.:** writing – original draft, visualization, supervision. **A. Kh.:** writing – review & editing, supervision. **A. A. B.:**

writing – review & editing, conceptualization. **N. N.:** data curation, validation. **S. F.:** validation, methodology.

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Conflict of Interest

The authors declare no conflict of interest.

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