



## Causes for Carcass Condemnations of Slaughtered Poultry in the Industrial Slaughterhouse of Namin, Ardabil Province, Iran

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### ABSTRACT

Poultry meat production worldwide has continued to expand over the last two decades. In this regard, hygienic meat inspection and monitoring of diseases at slaughter lines have been recognized as essential for assessing flocks' status. This study aimed to determine the condemnation rate of slaughtered poultry and calculate the economic losses due to condemnations in the Namin industrial slaughterhouse, Ardabil Province of Iran. The data were collected by a veterinarian inspector in the slaughterhouse. The number of poultry slaughtered, their weight, the number and weight of condemned carcasses, and the reasons for condemnation were recorded. In this study, 3,488,916 poultry were slaughtered, and 42,310 carcasses (1.202 %) were condemned, weighing 66,385 kg. The highest percentage of condemned poultry was observed in autumn (1.61%), and the lowest in spring (0.93%). The direct financial loss incurred due to condemnations was estimated to be as high as 153,067 USD. Septicemia and dead on arrival (DOA) were the most common reasons for the rejection of carcasses, accounting for 47.85% and 0.580 of the total condemnations and total slaughtered poultry, respectively. The highest frequency percentage of the condemnation due to diseases occurred during autumn. In contrast, summer had the highest condemnation rate in association with DOA. The current survey showed that diseases caused the most condemnations compared to other causes. Therefore, improving disease control programs on flocks and increasing the welfare of birds before slaughter is recommended.

### Keywords

Condemned carcasses, Septicemia, Dead on arrival, Slaughterhouse, Namin

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### Abbreviations

DOA: Dead on arrival  
USD: United States Dollar  
DEL: Direct economic loss  
NC: number of condemned poultry carcasses

P: average price of poultry carcasses (USD/Kg)  
W: average poultry carcasses weight (Kg).  
RLCL = ratio of condemnation losses to total condemnation economic losses

## Introduction

Regarding the importance of poultry production in providing the protein needed by human societies and the dramatical development of the poultry industry in recent decades, attention to hygienic carcass inspection in abattoirs has been increased to monitor production levels and assurance of meat quality [1]. Because of this issue, the need to establish and develop industrial slaughterhouses and hygienic inspection of slaughtered poultry has gained special importance, on the one hand, to prevent the transfer of live poultry to the consumption market as well as the spread of contamination caused by them, and on the other hand, to remove contaminated and unusable carcasses from the slaughter line by strict sanitary monitoring on the slaughter line. Finally, meat in completely hygienic conditions free from contamination and disease can be available to consumers [1-3].

Therefore, attention has shifted to the evaluation of the causes of carcass condemnation at slaughterhouses in many countries during recent decades. In a survey conducted from 2019 to 2020 in broiler slaughtered in Germany, the most common reasons for rejected carcasses were deep dermatitis (mean 0.63%) and ascites (mean 0.53%) [3]. Studies conducted over 6 years in the district of Olsztyn, Poland, showed that in the slaughterhouse inspection process, Mark's disease (MD) was seen in the internal and external organs of 2265 chickens (0.095%) [4]. According to the research by Santana et al. [5] from January to April 2007 in Brazil, the most common cause for condemnation in slaughterhouse A was related to cellulitis (4.25%). Various factors such as infectious diseases, ascite /peritonitis, mechanical factors (impact), cachexia, dead on arrival (DOA), poisoning, and tumors have been reported, which caused the condemnation of carcasses during the inspection process in abattoirs [1, 3, 4, 6-12].

In addition, the increase in condemnation rate due to diseases and other abnormalities will finally lead to great economic losses in the poultry industry [13-15]. Therefore, this study aimed to determine the rate and the causes of condemned carcasses and estimate economic losses due to condemnations in industrial slaughterhouse in Namin, Ardabil province, for one year.

## Abbreviations-Cont'd

CL: condemnation economic losses due to a specific cause (USD)

TL: total condemnation economic losses (USD)

RLSI= ratio of condemnation losses to total slaughter financial income

CL: condemnation economic losses due to a specific cause (USD)

TI: total slaughter financial income (USD)

## Results

The total number of slaughtered poultry in the industrial slaughterhouse of Nemin was 3,488,916, which included a total slaughter weight of 10,392,234 kg. During this study, 42,310 carcasses were condemned, accounting for 1.202% of the total slaughter and weighing 66,385 kg (Tables 1 and 2).

Statistical analysis shows a significant difference ( $p < 0.001$ ) among the total number of condemnation carcasses in different seasons. Despite the high slaughter rate in summer compared to other seasons, autumn had the highest rate of condemnations while the least of it was observed in spring (Table 1).

There is a significant difference among different seasons regarding the weight of condemned poultry carcasses ( $p < 0.001$ ). Thus, the lowest and highest weights of condemnations were in the spring and autumn seasons, respectively (Table 2).

The average annual direct economic loss due to condemnations is estimated at 4,089,058,000 Rial, equivalent to 153,067 USD. The highest economic loss was in autumn compared to other seasons (Table 3).

In this study, a total of nine reasons for the condemnation of carcasses were identified. The total number of condemnations and their percentage compared to the total number of condemned carcasses and slaughter are shown in Table 4. Of all condemned carcasses, the most condemnations, with 13,810 carcasses, were related to septicemia, which includes 32.64% of all condemnations and 0.396% of total slaughter. With 6,437 carcasses, 15.21% of total condemnations, and 0.184% of the total slaughter, DOA is in the second rank. The lowest condemned carcasses were due to contusion/fracture/ bruising, with 0.20% of the total condemnations and 0.002 % of the total slaughter. According to the findings from Table 4, from all condemned carcasses, the highest weight of condemnations, with a weight of 22,460 kg, was related to septicemia, which was included 33.83% and 0.216% of the total weight of the condemned carcasses and the total slaughter, respectively. The resulting losses were estimated at 49,511 USD. In the second rank was the DOA with a weight of 15,231 kg, which constituted 22.94 % of the total weight of condemnations and 0.146 % of the total slaughter weight, and economic losses caused by it were estimated at 37,069 USD. The lowest weight of condemned carcasses was due to contusion/fracture/ bruising, with 0.21% of the total condemnations and 0.001 % of the total slaughter. The economic loss related to it was calculated at 329 USD.

Frequency percentages of septicemia, ascites/peritonitis, poisoning, arthritis/synovitis, cachexia, cellulite, contusion/fracture/ bruising, and CRD in autumn were higher than in other seasons. Whereas

Causes for the carcass condemnations of the slaughtered poultry

**Table 1.**

Comparison of the total number of slaughtered and healthy carcasses and the total number of condemned carcasses in the industrial slaughterhouse of Namin during different seasons.

Seasons	Number of slaughter	Number of healthy carcasses	Number of condemnations (%)
April–June	797,819	790,388	7,431 (0.93)
July–September	984,560	971,656	12,904(1.31)
October–December	906,207	892,107	14,100 (1.61)
January–March	800,330	792,455	7,875 (1.01)
Total	3,488,916	3,446,606	42,310 (1.20)

$\chi^2(3)=1532, p = < 0.001$

**Table 2.**

Comparison of net weight of slaughter and healthy carcasses and weight of condemned carcasses in the industrial slaughterhouse of Namin during different seasons.

Seasons	Weight of slaughter	Weight of healthy carcasses	Weight of condemnations (%)
April–June	2,473,930	2,462,270	11,660 (0.47)
July–September	2,905,204	2,884,665	20,539(0.70)
October–December	2,797,645	2,774,396	23,249 (0.83)
January–March	2,215,455	2,204,518	10,937 (0.49)
Total	10,392,234	10,325,849	66,385 (0.63)

$\chi^2(3)=3696, p = < 0.001$

**Table 3.**

Comparison of economic income of slaughter and healthy carcasses and economic losses of condemnations in the industrial slaughterhouse of Namin during different seasons.

Seasons	Economic income from slaughter	Economic income of healthy carcasses	Economic losses of condemnations (%)
April–June	6,461,581	6,431,127	30,454 (0.47)
July–September	7,020,145	6,970,514	49,631(0.70)
October–December	5,777,622	5,729,609	48,013 (0.83)
January–March	5,057,841	5,032,872	24,969 (0.49)
Total	24,317,189	24,164,122	153,067 (0.63)

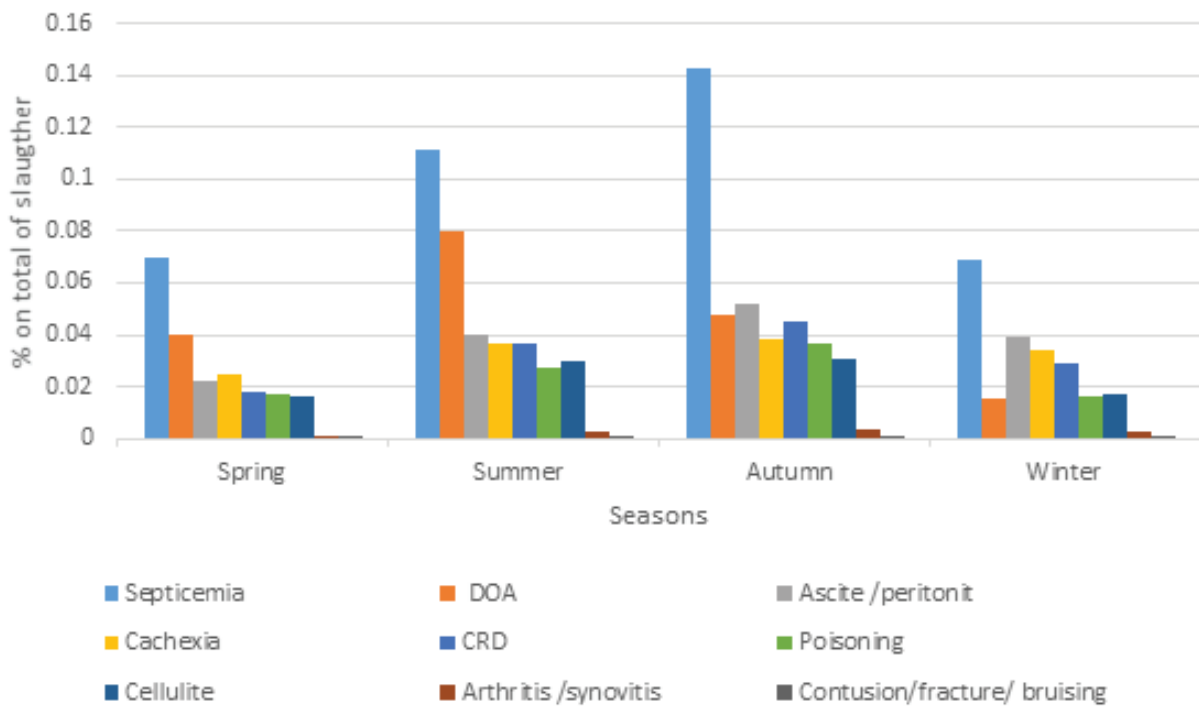
$\chi^2(3)=5325, p = < 0.001$

summer had the highest frequency percentages of condemnations related to dead on arrival (Fig 1).

**Table 4.** Number, weight and financial losses of condemned carcasses according to their causes in the slaughterhouse of Namin.

Cause of tions	condemna- No.	CTC (%)	CTS (%)	WC Kg	RWCW (%)	RWSW (%)	ELC	RLCL	RLSI
Septicemia	13,810	32.64	0.396	22,460	33.83	0.216	49,511.47	32.35	0.203
DOA	6,437	15.21	0.184	15,231	22.94	0.146	37,069.05	24.22	0.152
Ascite /peritonit	5,439	12.85	0.155	8,203	12.35	0.078	17,446.90	11.40	0.071
Cachexia	4,725	11.16	0.135	2,610	3.93	0.025	6,287.71	4.11	0.025
CRD	4,591	10.85	0.131	6,799	10.24	0.065	16,254.70	10.62	0.066
Poisoning	3,481	8.22	0.099	5,335	8.03	0.051	12,774.13	8.34	0.052
Cellulite	3,343	7.90	0.095	5,004	7.53	0.048	12,033.07	7.86	0.049
Arthritis /synovitis	397	0.94	0.011	603	0.90	0.005	1,360.13	0.89	0.005
Contusion/fracture/ bruising	87	0.20	0.002	140	0.21	0.001	329.93	0.21	0.001
<b>Total condemnations</b>	<b>42,310</b>	<b>100</b>	<b>1.202</b>						
<b>Total weight of con- demnations</b>				<b>66,385</b>	<b>100</b>	<b>0.638</b>			
<b>Total direct economic losses</b>							<b>153,067</b>	<b>100</b>	<b>0.629</b>

No: Number. CTC: Ratio of condemnation number to total condemnations. CTS: Ratio of condemnation number to total slaughter. WC :Weight of condemnations. RWCW: Ratio of condemnation weight to total condemnation weight. RWSW:Ratio of condemnation weight to total slaughter weight. ELC: Economic losses of condemnations. RLCL :Ratio of condemnation economic losses to total condemnation economic losses. RLSI :Ratio of condemnation economic losses to total slaughter financial income. DOA: dead-on arrival.



**Figure 1.** Seasonal frequency of condemnation causes in the industrial slaughterhouse of Namin.



## Discussion

Every year, in different parts of the world, extensive research is conducted on the causes of condemnation carcasses, which is very important to identify and determine the distribution of diseases to prevent carcass condemnation and ultimately reduce financial losses [5, 7, 13-14]. Researchers have shown that the proportion of total carcass condemnation to slaughtered birds and the reasons for condemnations differ in countries [4, 6]. This difference is related to ecological conditions, epidemiology of diseases, age and type of slaughtered poultry, and management practice of poultry in every country [4, 6].

According to Bremner [2] studies in England and Wales from 1992 to 1993, 1.3% of all slaughtered broilers were condemned for various causes, and septicemia /toxemia/fever were the most common causes of condemnation (65.6%). Herenda and Jakel [8] investigated causes for carcass condemnations in Ontario, Canada, between 1991 and 1992. Out of 9,829,296 slaughtered broilers, 100,369 (1.02%) were rejected; ascites and cellulitis were the most frequent reasons for condemned carcasses (0.52%). A survey conducted in Olsztyn, Poland, during 1986-1991 showed that 1.66% was condemned from 37,779,959 slaughtered poultry, and the most common reason for the condemned chicken carcasses was related to Marek's disease [4]. The research carried out by Petracci et al. (2006) on 1266 million broilers in thirty-three slaughterhouses from 2001 to 2005 in Italy shows that the average percentage of DOA was 0.35 and its rate significantly increased during summer. Mukaratirwa et al. [10] showed that from 1999 to 2005, out of 55,957 ostriches slaughtered in Norton, Zimbabwe, 0.05% of the carcasses were rejected due to septicemia. In another study conducted by Dzoma et al. [7] between 2001 and 2005 in Botswana, 3,814 ostriches were referred to the slaughterhouse; during an inspection, 949 organs were rejected for various reasons, and the highest condemnations were due to lungs. Santana et al. [5] studied two slaughterhouses in Goias State, Brazil, from January to April 2007. Of 40,732,773 and 6,457,166 slaughtered poultry in slaughterhouses A and B, 3,384,861 (8.3%) and 235,014 (3.6%) carcasses were rejected, respectively. The most common causes of condemnations in slaughterhouse A, with 51.20% of all condemned carcasses and 4.25% of all slaughter, were observed due to cellulite. In contrast, in slaughterhouse B, fracture and bruising, with 28.90% of all condemnations and 1.04% of all slaughter, were the most common causes of condemnations.

A survey conducted on 404 broiler flocks referred to 15 industrial slaughterhouses in western France during 2008 reported 0.87% of condemned carcasses, and the highest condemnations were related to

cachexia 0.30% and hyperemia (0.22%) [16]. In a study accomplished by Haslam et al. [17] in England, the mean percentage of rejection was 1.23%, and the main reason for cause condemnation was reported to be acute internal pathology (0.22%) and Cachexia (0.20%). Alloui et al. [18] studied the condemnation rate in the poultry slaughterhouse of Batna City (Algeria), where 8.4 % of carcasses were rejected, and the major causes of condemnations were congestion, skin lesions, cachexia. In the report of Mwimali et al. [19], 405,778 (1.88%) birds were condemned from 21,549,233 slaughtered broilers in Kenya, which Ascites and DOA were the most frequent causes of rejection (92.74%).

In 2017, Salines et al. [12] investigated the reasons for the condemnation of broilers at 10 slaughterhouses in France which the most common reason for condemnations was cachexia (41.8 %), generalised congestion (29.3%) and non-purulent cutaneous lesions (14.2%). Abdelrahman et al. [13] reported that 49,638 (0.95%) and 16,382 (0.32%) of total slaughtered poultry (5,181,189) in at Damietta poultry abattoir, Damietta governorate, Egypt, were condemned for DOA and condemned broilers, respectively. Cellulitis (11.2%), ascites (10.5%), and septicemia (9.7%) were the most important causes of condemnation, and the annual total economic loss was 2668600.2 EC/P. In another study, 33,54,747 slaughtered broilers were surveyed in England slaughterhouses from 2017–2018, and ascites and abnormal colour were the main reason for condemnations [20]. According to a study by Törmä et al. [21] from approximately 370 million broilers slaughtered in four Finnish slaughterhouses from 2015–2019, the condemnation rate varied between 2.6% and 4.8%, and Cellulitis (0.3–1.0%), ascites (0.3–0.4%), and body cavity disorders (0.2–0.3%) were the most common condemnation causes. A survey by Alfifi et al. [22] in a main slaughterhouse in Denmark from 2020 to 2021 showed that from 17,331,511 slaughtered chickens, 205,879 (1.2%) carcasses were condemned. The main causes of condemnations were due to scratches (23.6%), cellulitis (19.2%), and hepatitis (8.3%).

The studies carried out in Iran have reported that the rate and reasons for condemnations vary in different regions. Research conducted by Ansari-Lari and Rezaghali [6] on eleven industrial slaughterhouses in Fars province from 2002 to 2006 shows that out of the total 130,967,021 slaughtered poultry, 959,416 (0.73%) carcasses were condemned; 62% (595,287) of all condemnations were related to cachexia and septicemia. A study of Jalilnia and Movassagh [23] in the industrial slaughterhouse of East Azarbaijan Province in 2011 revealed that from the total of 14,788,995 slaughtered poultry, 55,325 (0.37%) carcasses were

condemned, and the most causes for condemnation was due to cachexia (30.46%). Hosseini Aliabad et al. [9] reported that 380140 poultry were slaughtered in the Nowshahr slaughterhouse between 2005 and 2006, where 2,548 carcasses (0.67%) were condemned; the DOA was the highest condemned carcasses (0.172%).

In a study conducted by Gholami et al. [15] in 28 slaughterhouses of Tehran province from 2009 to 2011, out of a total of 214,997,429 slaughtered poultry, 705,046 (0.33%) carcasses were rejected; cachexia was the most cause for condemnations (46.57%). Also, they estimated the average annual economic loss due to the condemnations of 14,594,452,200 rials. In the Khodaei-Motlagha et al. [24] study, the most common causes for condemnations of slaughtered broilers in Shanzand slaughterhouse were due to excessive atrophy, trauma, and septicemia during 6 months in 2009. According to reports by Ghaniei et al. [14] at 11 abat-toirs in West Azerbaijan province from 2008 to 2015, 171,297,886 poultry were slaughtered, and 1,580,570 (0.92 %) poultry carcasses were condemned for different reasons: septicemia and cachexia were the most common reasons for the condemnation (60.3%) and financial loss due to condemnation was estimated to be as high as 3,731,905 USD.

The present study condemned 42,310 carcasses (1.202%) for various reasons. The 1.202% rate for condemnation in our study is similar to those of Bremner [2], Abdelrahman et al. [13], Haslam et al. [17], and Alfifi et al. [22], who reported 1.30%, 1.27%, 1.23%, and 1.20%, respectively. However, it varied substantially with other studies. The condemnation rate of our study is higher than those reported by Gholami et al. [15] (0.33%), Jalilnia and Movassagh [23] (0.37%), Hosseini Aliabad et al. [9] (0.67%), Ansari-Lari and Rezaghali [6] (0.73%), Ghaniei et al. [14] (0.92%) and Herenda & Jakel [8] (1.02%) and Salines et al. [12] (1.04%). While it is lower than rates reported by Al-loui et al. [18] 8.4% in Algeria, Santana et al. [5] 8.3% and 3.6% for two different slaughterhouses in South America, Törmä et al. [21] between 2.6% and 4.8% in Finnish, Radkowski et al. [4] 1.66% in Poland, Jung-hans et al. [3] 1.48% in Germany and Kittelsen et al. [25] mean 1.4% in Norway.

As shown above, the overall rate of condemnation was different compared with other studies; the reasons for the condemnation were also different. In this survey, of all the condemnations, the most frequent causes of condemned carcasses belonged to septicemia and DOA (20,247 carcasses). So it can be said that the rate of condemnation related to these two factors is very significant compared to other causes, including 47.85% and 0.580% of the condemnations and the total of slaughtered poultry, respectively. The highest financial losses in the present study were observed

due to septicemia and DOA; the estimated economic losses related to these two reasons (86,580 USD) are much higher than other causes and constitute 56.52% of the total economic losses.

The highest incidence rate of septicemia was observed in autumn during this study. Septicemia is an almost non-specific term and indicates an infectious disease whose clinical diagnosis is based on carcass congestion, muscle darkening, kidney inflammation, and inflammatory lesions such as airsacculitis and perihepatitis [1]. Various microbial causes cause septicemia, the most important of which are *E.coli*, influenza, *Salmonella enteridis*, and *Pasteurella multocida*, important pathogens of human relevance [6]. In this work, bacteriologic examination on septicemic carcasses was not done. However, identifying the microorganisms causing septicemia is highly recommended in future works, which might have important public health implications.

Mortalities due to DOA have welfare and great economic implications in the poultry industry [13]. This study revealed an increased frequency of DOA in summer, similar to the report provided by Salines et al. [12] Incidence of high mortality of DOA in the hot months of the year may reflect the effects of hot stress during the time of broiler harvest and transport and also increased transit times [12]. DOA are carcasses that have perished between the farm and the slaughter or before slaughter. The main reason is the failure to comply with management issues in transporting poultry from farms to the slaughterhouse, which other things can mention for heat stress and humidity in early summer, especially in July, feed and water withdrawal, long transit times, physical injury, environmental condition, high ambient temperature, and overcrowding [13, 18, 25]. This study showed that most reasons for condemnations are due to diseases, accounting for 84.59%. The estimated annual economic losses during this survey were 115,669 USD for diseases and 37,069 USD for DOA. The high rate of condemnations for diseases in colder months was logical.

## Conclusion

The meat inspection records in the present survey are a useful tool to help monitor the status of diseases on the flocks and the welfare of birds, which can be used as prevention measures. Therefore, improving disease control programs on flocks and increasing the welfare of birds from flocks to slaughter is necessary. The present results can act as baseline data for the future monitoring of condemnations in poultry slaughterhouses.

## Materials & Methods

### Study Design and Data Collection

This study was carried out using a cross-sectional method from April 2019 to March 2020. Data were obtained with the help of an experienced team of veterinarians. In this survey, DOA and condemned carcasses in the Parkan slaughterhouse of Namin, located in Ardabil province, were investigated. Under the supervision of the responsible veterinarian on the slaughter chain, the total number of slaughtered poultry (broiler, broiler breeder, turkey) and their weight were recorded daily, and in the second stage, after isolating and weighing unusable carcasses, the number of condemnations were recorded and then causes of condemnations were identified based on their morphological characteristics and symptoms, as well as necropsy lesions [6].

Finally, data were collected separately in tables. The prevalence rate was sorted monthly to determine the difference between the distribution of condemned carcasses and the season. The overall rate of condemnations for the one year was also determined. The proportions (%) of condemnations were calculated considering the number and weight of rejected carcasses due to a specific cause against the total number and weight of condemned carcasses and slaughtered poultry.

### Inspection of Poultry

Veterinarians carried out routine meat inspection, and condemnation was dependent on the inspector's experience. In Brief, hygienic carcass inspections were performed in two stages in the abattoir: before slaughter (stage I) and post-slaughter (stage II) [1]. In the first stage of the inspection (before weighing), were taken a sanitary license from the veterinary organization and records of the poultry, including age, average weight, ration type, and diseases involved during the breeding period; then all the poultry were transferred to the slaughter line and inspected before blood sampling. At this stage, acute infectious diseases, cachexia, DOA, general contamination, common infections, and abnormal smells were diagnosed.

The post-slaughter inspection was carried out in three stages, in which the surface parts of the body, intestines, and visceral and internal cavities of the body were inspected, and in this process, inedible carcasses were rejected from the cycle of slaughter; after ending the inspection and unloading of intestines and viscera to obtain the net weight of slaughter, carcasses were weighed. In this study, the net weight of slaughter was 72.4 to 72.6% of the slaughter.

### Assessment of the Financial Loss

The direct economic losses due to condemnation were calculated by this formula:

$$DEL = NC \times P \times W$$

The Average sell price of carcasses (p) was calculated based on the prices of slaughtered poultry (Rials/kg) for Ardabil province, which is announced on the website of Iran Poultry Industry Information and Communication Technologies Institute ([www.itpnews.com](http://www.itpnews.com)) daily, monthly, and annual. Then, the monthly average sell price of condemned carcasses was estimated in Rial. Later, the calculated Rial was converted into Dollars by checking the reliable currency sell markets such as the Bank Melli Iran ([www.bmi.ir](http://www.bmi.ir)) in Tehran province during different months. The average annual sell prices for each kilogram of carcasses were 61,596 Rial or 2.3 USD.

The Average poultry carcass weights (W) were determined by weighting 100 carcasses of different ages. The average weights were calculated as 0.5 kg, 1.6 kg, and 2.3kg for cachexia, diseases, and DOA in this region, respectively.

The proportions (%) of condemnation economic loss were calculated by these formulas:

$$RLCL = CL \div TL \times 100$$

$$RLSI = CL \div TI \times 100$$

In this study, SPSS software was used for statistical data analysis. Sea-

sonal patterns of variables were investigated with the chi-square ( $\chi^2$ ) test. The P-value less than 0.05 is considered statistically significant.

### Authors' Contributions

Aidin Azizpour: Supervision, Planning, Conceptualization, Visualization, Writing- Reviewing and Editing Manuscript. Zahra Amirajam: Supervision, Investigation, Data Analysis, Resources and Validation.

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### Conflict of interest

The authors declare that there is no conflict of the interest

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