



# Major Causes and Associated Economic Losses of Carcass and Organ Condemnation in Cattle and Sheep in the Northern Part of Palestine

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## ABSTRACT

Identifying and quantifying the causes of condemnation of carcasses and organs at the slaughterhouse level is the first step in disease surveillance aimed at preventing or decreasing losses at the abattoir. The aim of this study was to evaluate the causes of organ and carcass condemnations and the financial loss due to these condemnations. A slaughterhouse survey was conducted for six months to determine the major causes of carcass and organ condemnation in cattle and sheep and the associated financial loss at the Nablus Municipal Slaughterhouse at the West Bank in Palestine. A total of 6344 sheep, and 3042 cattle were examined during this period. The condemnations were registered during standard postmortem pathological examination done by the veterinarians at the slaughterhouse. The results of organ condemnation during the study period showed that seven whole carcasses, 77 whole offal, 208 livers, 692 lungs, 46 hearts, 273 kidneys, and 96 spleens were condemned during this period. The financial loss due to the rejection of carcass and organs from the slaughtered animals during the study period was estimated to be 16356 USD. Both parasitic infestations and bacterial diseases were responsible for the highest economic losses, although other pathological lesions such as fatty change, incomplete bleeding, discoloration and tumors, were also encountered. The results of this slaughterhouse study showed that the parasitic infestations were the most common cause of condemnations in sheep, and bacterial diseases were the most common cause of condemnations in cattle. There was no doubt that effective disease control programs and preventive measures should be immediately implemented in the Palestinian territories to prevent and decrease the causes of diseases transmitted through meat. The emphasis should be placed on effective meat inspection, proper disposal of organ condemnation and standard animal husbandry health care to exclude zoonotic diseases and associated financial loss.

ORIGINAL ARTICLE  
 pii: S232245681900040-9  
 Received: 10 Nov 2019  
 Accepted: 17 Dec 2019

**Keywords:** Carcass and organ condemnation, Cattle and sheep, Economic losses, Palestine, Slaughterhouse

## INTRODUCTION

The human population is growing fast in different countries around the world, this growth rate is faster than the growth rate in animal production (Steinfeld et al., 2006). According to united nations population division report, the world population is expected to an increase of about one billion people within the next 15 years, reaching about 8.5 billion in 2030, and to a further increase to about ten billion in 2050 (UNDP, 2017). The production of sufficient amounts of high quality, affordable, and safe food requires the sustainable use of scarce agricultural resources with less waste (Jaja et al., 2017). Livestock plays a main part in food security, where it is considered a valuable asset and a source of wealth (FAO, 2018). The majority of the developing countries are located in the tropics and livestock production is crucial to their economy (Thornton, 2010; Kassahun et al., 2017).

According to the Palestinian Central Bureau of Statistics, the estimated Palestinian population in the West Bank was 2.9 million, and the slaughtered cattle and sheep for the same year and the same area was estimated to be 37437 cattle and 45308 sheep and goat (PCBS, 2017). The main source of red meat in this area includes sheep, cattle and goat and their products. Bacterial, viral, and parasitic diseases cause significant losses resulting from the death of animals, inferior weight gain, condemnation of offal and carcasses at the slaughterhouse and increase expenditure for animals' treatments (Abebe et al., 2010; Kassahun et al., 2017). There is no available abattoir data about the major causes of carcass and organ condemnation in Palestine, as there is just few efficiently working slaughterhouses at the Palestinian territories. In addition, the available data about the main causes of carcass and organ condemnation in different countries varies significantly, and there is scarcity of abattoir data in many countries around the world. Whole carcass condemnation in Swiss cattle was mainly because of meat condition that was unfit for human consumption due to abnormal color and consistency, followed by symptoms of pyaemia, septicemia, toxemia, bacteremia or viremia (Vial et al., 2015). In Bursa province, Turkey, carcasses were condemned mainly due to tuberculosis and jaundice, and organ condemnation was mainly due to hydatidosis and fasciolosis (Yibar et al., 2015). Parasitic infestations were the major

cause of abattoir condemnations in many parts of Africa (Jaja et al., 2017; Nasir and Abebe, 2016; Negero and Ferede, 2017; Molla et al., 2019). Contagious bovine pleuropneumonia and tuberculosis were the major causes of carcass and organ condemnations in Ghana (Jarikre et al., 2014; Mohammed et al., 2018). Cases of tuberculosis were very rare in slaughtered animals at the Nablus Municipal Slaughterhouse in Palestine, where this study was conducted. The production loss to the livestock industry worldwide is estimated more than 900 million USD annually (Getachew, 2008; Abebe and Yilma, 2012; Mohammed et al., 2018).

Therefore, meat should be clean and free from diseases in order to protect public health. Also one of main objects in meat inspection is to provide safe and wholesome meat for human consumption. The responsibility for achieving this objective lies primarily with the relevant public health authorities who are represented by veterinarians and meat inspectors at the abattoir stage. Meat inspection and meat hygiene provide a safeguard to ensure that meat and meat products are safe and wholesome for human consumption (Tembo and Nonga, 2015). The classical ante-mortem and post-mortem procedures were designed to detect diseases in animals before slaughter and the lesions produced by these diseases after slaughter respectively (Herenda et al., 2000; Nasir and Abebe, 2016). Affected carcasses and organs with lesions of zoonotic diseases are condemned at slaughter, which can also limit zoonotic diseases' transmission to humans via meat (Jibat et al., 2008; Komba et al., 2012). Appropriate meat inspection procedures can be only done where slaughterhouses are established and work effectively.

This study aimed to determine the major causes of organs and carcass condemnation at the northern part of Palestine, and to assess the direct financial loss due to both total and partial condemnation of organ and carcass.

## **MATERIALS AND METHODS**

### **The study area**

There are eight working slaughterhouses in the West Bank of Palestine (Palestinian Ministry of Agriculture, 2016). The Nablus Municipal Slaughterhouse is one of the largest slaughterhouses at the northern area of the West Bank, slaughtering about 6048 cattle and 12822 sheep annually, these slaughtered animals worth in total 16926600 USD and represent about 16.2% and 28.3% of the cattle and sheep slaughtered in Palestine respectively. The inspected animals were brought to the abattoir from different parts of the West Bank, mainly from the northern part including the district of Nablus and the surrounding area with the refugee camps. The carcasses at the slaughterhouses are divided and stamped according to age, which is determined by dentition. Carcasses from animals, either cattle or sheep, older than one-year-old are stamped with red color. Carcasses from animals younger than one year are stamped with dark blue/violet color.

### **Methods of inspection**

Meat inspection was done by the meat inspectors at the slaughterhouse including two veterinarians and their assistants. Detailed organoleptic examination of carcass and organs was done by differentiate between the parasitic infestations and bacterial/viral infections. The parasitic infestation usually at developmental stages of parasites are seen in predilection sites or specific organs, which must be examined in routine meat inspection procedures to look for these parasites and/or their larval stages. The head was inspected first for determination of age, then the masseter muscles and the tongue of cattle were visually inspected and palpated, then they were incised to look for any lesions and cysts. The lungs were visually inspected, palpated and incised. The trachea and bronchi were incised and examined for any lesions. The heart and pericardium were visually assessed and incised to expose the heart chambers. These were inspected for any parasitic cysts and lesions. The liver was palpated and incised to expose the bile ducts and assessed for any lesions and parasites. The spleen, kidneys and gastrointestinal tracts including the associated lymph nodes were visually inspected and palpated.

### **Data collection and evaluation**

Bacterial infections, parasitic infestations, and pathological lesions responsible for the condemnation of the carcasses and offal during meat inspection were organoleptically determined from the period between July and December 2018. Viral infections were included within the bacterial infections. Pathological lesions included all lesions other than parasitic infestations and bacterial infections. These lesions included cases of bruising, imperfect bleeding, hematoma, poorness, edema, abnormal odors, anthracosis, melanosis, blood aspiration, fatty changes, tumors, renal calculi, renal infarcts, ketosis, intensive dark firm and dry (DFD) meat and metabolic disorders.

Postmortem inspection and data collection were performed by the responsible veterinarians involved in routine meat inspection at the abattoir with the help of the author of this study. The total economic losses were calculated according to the retail price of meat and offal according to average market prices in Palestine. The retail price of offal (lung, liver, kidney, heart, and spleen) was calculated as a unit-price, while for whole carcasses of sheep, goat and cattle, the price was calculated per kilogram price. The total economic losses included the summation of prices of the meat condemnation and the offal, resulted in a total loss of 16356 USD.

## RESULTS

During the six-month study period, a total number of animals comprising 6344 sheep and 3042 cattle were slaughtered and examined. The daily average number of animals slaughtered in this slaughterhouse was 65 and 25 for sheep and cattle, respectively. The highest financial loss in cattle was in whole carcass condemnations (4000 USD) that were mainly due to bacterial and viral infections that represent 50% of the condemnations. Condemnation of bovine livers that contributed in 3600 USD loss were mainly due to liver abscesses in calves due to *Fusobacterium necrophorum*, and for old cattle were mainly due to adhesions, hepatitis and peritonitis. Kidneys' condemnations contributed in 2080 USD losses mainly due to nephritis and other bacterial infections. Spleens were mainly condemned due to blood parasites mainly light babesiosis that caused lesions in the spleen.

Table 1 presented the main organ and carcass condemnations for cattle due to bacterial and viral infections and the associated losses. The main cause of condemnation of whole carcasses in cattle was due to traumatic reticulopericarditis/peritonitis, followed by condemnations of livers and kidneys that were mainly due to abscesses and nephritis respectively. Table 2 presented the main organ and carcass condemnations for cattle due to parasitic infestations and the associated economic losses due to these condemnations. The main cause of condemnation was a whole carcass due to heavy infestation with *Taenia saginata* cysts that causes a loss of 1000 USD, followed by liver condemnations that were mainly due to fasciolosis in young imported calves, and echinococcosis in old cows. Fasciolosis is rare in local animals due to the absence of the snails needed for the completion of the life cycle. Table 3 presented the main organ and carcass condemnations for cattle due to pathological changes other than parasitic, bacterial and viral infections, and the associated economic losses due to these condemnations. The main cause of condemnation with the highest loss (1000 USD) were due to advanced case of ketosis, followed by condemnation of livers that were mainly due to melanosis and fatty changes. As presented in table 4, parasitic infestations were the main cause of organ and carcass condemnation in sheep which contributed in a total loss of 2260 USD. The highest financial loss were in whole carcass condemnations of sheep (1000 USD) that were mainly due to heavy parasitic infestation caused by *Taenia ovis* cysts. The total liver condemnations in sheep due to different causes, contributed in a total of 1180 USD losses. The main cause of these liver condemnation was due to parasitic infestation of *Taenia hydatigena* in young sheep and *Echinococcus granulosus* in old sheep. More than one case of sheep carcass was recorded to harbor three different cystic stages of tape worms (*T. ovis* cysts, *T. hydatigena* cysts, and *E. granulosus* cysts). Whole offal condemnations in sheep contributed in 1242 USD in general. These losses were mainly due to bacterial diseases (Table 5) due to adhesions and peritonitis. Lung condemnations in sheep contributed in 996 USD in general, that were mainly due to bacterial and viral diseases due to pneumonia, pleuritis and bronchopneumonia in young sheep and parasitic infestations in old sheep mainly due to *E. granulosus* and lung worms as *Dictyocaulus* spp. Other pathological lesions including fatty change in the liver due to pregnancy toxemia, anthracosis in the lungs due to inhalation of smoke and dust, melanosis, blood aspiration and kidney stones were also encountered as shown in table 6. Condemnations of the lung and liver due to pathological changes were mainly due to melanosis and fatty changes in lungs and livers respectively. Fatty changes in the livers were attributed mainly to pregnancy toxemia. Anthracosis, blood aspiration due to mechanical error during slaughtering, and other lesions were also encountered.

**Table 1.** Number of different organs, carcass condemnation and financial loss in cattle due to bacteria/viral infections in the northern part of Palestine from July 2018 to December 2018

Organ condemnation	Age group	Condemnation number	Bacterial and Viral infections	Percent of condemnation	Unit price (USD)	Financial loss (USD)
Whole carcasses	Young	0	--	--	2500	2000
	Old	4	2	50	1000	
Livers	Young	33	18	55	40	1880
	Old	57	29	51		
Lungs	Young	90	78	87	4	616
	Adult	104	76	73		
Kidneys	Young	138	65	47	8	1304
	Old	122	98	80		
Spleens	Young	11	2	18	4	24
	Old	22	4	18		
Hearts	Young	3	1	33	7	28
	Old	5	3	60		
Whole offal	Young	3	3	100	63	378
	Old	5	3	60		
<b>Summation of the financial loss in USD</b>						<b>6230</b>

USD: United States dollar

**Table 2.** Number of different organs, carcass condemnation and financial loss in cattle due to parasitic infestations in northern part of Palestine from July 2018 to December 2018

Organ condemnation	Age group	Condemnation number	Bacterial and Viral infections	Percent of condemnation	Unit price (USD)	Financial loss (USD)
Whole carcasses	Young	0	---	---	2500	----
	Old	4	1	25	1000	1000
Livers	Young	33	5	15	40	680
	Old	57	12	21		
Lungs	Young	90	---	---	4	72
	Adult	104	18	17		
Kidneys	Young	138	----	---	8	64
	Old	122	8	7		
Spleens	Young	11	7	64	4	80
	Old	22	13	59		
Hearts	Young	3	2	67	7	28
	Old	5	2	40		
Whole offal	Young	3	---	---	63	126
	Old	5	2	40		
<b>Summation of the financial loss in USD</b>						<b>2050</b>

USD: United States Dollar

**Table 3.** Number of different organs, carcass condemnation and financial loss in cattle due to pathological changes in the northern part of Palestine from July 2018 to December 2018

Organ condemnation	Age group	Condemnation number	Bacterial and Viral infections	Percent of condemnation	Unit price (USD)	Financial loss (USD)
Whole carcasses	Young	0	---	---	2500	----
	Old	4	1	25	1000	1000
Livers	Young	33	10	30	40	1040
	Old	57	16	28		
Lungs	Young	90	12	13	4	88
	Adult	104	10	10		
Kidneys	Young	138	73	53	8	712
	Old	122	16	13		
Spleens	Young	11	2	18	4	28
	Old	22	5	23		
<b>Summation of the financial loss in USD</b>						<b>2868</b>

USD: United States Dollar

**Table 4.** Number of different organs, carcass condemnation and financial loss in sheep due to parasitic infestations in the northern part of Palestine from July 2018 to December 2018

Organ condemnation	Age group	Condemnation number	Bacterial and Viral infections	Percent of condemnation	Unit price (USD)	Financial loss (USD)
Whole carcasses	Young	3	2	67	500	1000
	Old	0	---	---	300	----
Livers	Young	88	46	52	10	670
	Old	30	21	70		
Lungs	Young	394	58	15	2	210
	Adult	104	47	45		
Spleens	Young	56	48	86	1.5	80
	Old	7	5	72		
Hearts	Young	36	8	22	1.5	12
	Old	2	---	---		
Whole offal	Young	22	7	32	18	288
	Old	47	9	19		
<b>Summation of the financial loss in USD</b>						<b>2260</b>

USD: United States Dollar

**Table 5.** Number of different organs, carcass condemnation and financial loss in sheep due to bacterial/viral infections in northern part of Palestine from July 2018 to December 2018

Organ condemnation	Age group	Condemnation number	Bacterial and Viral infections	Percent of condemnation	Unit price (USD)	Financial loss (USD)
Whole carcasses	Young	3	1	33	500	500
	Old	0	---	---	300	---
Livers	Young	88	22	25	10	270
	Old	30	5	17		
Lungs	Young	394	178	45	2	412
	Adult	104	28	27		
Kidneys	Young	5	4	80	3	30
	Old	8	6	75		
Spleens	Young	56	5	9	1.5	9
	Old	7	1	14		
Hearts	Young	36	28	78	1.5	45
	Old	2	2	100		
Whole offal	Young	22	15	68	18	954
	Old	47	38	81		
<b>Summation of the financial loss in USD</b>						<b>2220</b>

USD: United States Dollar

**Table 6.** Number of different organs, carcass condemnation and financial loss in sheep due to pathological changes in the northern part of Palestine from July 2018 to December 2018

Organ condemnation	Age group	Condemnation number	Bacterial and Viral infections	Percent of condemnation	Unit price (USD)	Financial loss (USD)
Livers	Young	88	20	23	10	240
	Old	30	4	13		
Lungs	Young	394	158	40	2	374
	Adult	104	29	28		
Kidneys	Young	5	1	20	3	9
	Old	8	2	25		
Spleens	Young	56	3	5	1.5	6
	Old	7	1	14		
<b>Summation of the financial loss in USD</b>						<b>629</b>

USD: United States dollar

## DISCUSSION

An important function of meat inspection is assist to monitoring diseases in the national herd and flock by providing feedback information to veterinary services to control or eradicate diseases, to produce wholesome products and to protect the public from zoonotic hazards (Gracey et al., 1999). Proper meat inspection is essential to remove abnormalities from meat and its products and surveillance at the abattoir will help to exclude animals or carcasses, which may cause a public health hazard, from human food chain (Arbabi and Hooshy., 2006; Abbuna et al., 2010; Alton et al., 2010; Decaudin et al., 2017). Although the condemnation data obtained from slaughterhouses remain under-used (Stärk, 2017), slaughterhouse surveillance can help to ascertain the extent of human exposure to certain zoonotic diseases, and to estimate the financial loss of carcass condemnations (Jobre et al., 1996; Mandefro et al., 2015).

From the results obtained it can be clearly seen that parasitic infestations play a major role in organ and carcass condemnation mainly in sheep. Many of these parasitic infestations can be attributed to the presence of stray dogs and cats harboring different stages of the parasites and transmitting these to the farm animals during grazing. The fact that parasitic infestations were clear in sheep more than cattle can be explained that cattle are usually housed and have little exposure to animals harboring the different developmental stages of parasites, especially dogs and cats. Also old sheep that are usually producing ewes are more exposed to parasitic infestations during foraging than young sheep that are usually housed, fed high protein diet and slaughtered in young ages for meat production. These results comply with other research works (Jobre et al., 1996; Mellau et al., 2010; Abebe and Yilma, 2012; Yibar et al., 2015; Jemal and Kebede, 2016), which showed that parasites are responsible for great losses to the meat industry more than any other diseases, and these infestations did not only cause clinical disease and mortality but also cause economic losses through production losses in the livestock industry as reduced milk, meat, wool, hide production and infertility. The results obtained from this study reflect almost the same situation in other slaughterhouses in Palestine. Some reports by Jarikre

et al. (2014); Vial et al. (2015); Yibar et al. (2015) and Mohammed et al. (2018) showed that infections such as tuberculosis and contagious bovine pleuropneumonia, lesions caused by bacteremia, viremia, and toxemia, in addition to abnormal color and consistency, were the major causes of carcass and organ condemnation in some countries. Close monitoring of meat hygiene, including proper implementation of meat inspection procedures during slaughter, should be a vital part of the national public health protection program (Pal et al., 2017).

## CONCLUSION

Retrospective studies of diseases encountered at abattoirs provide useful prevalence and pathology profiles which can be used in risk assessment or future planning of zoonotic disease control and prevention strategies. Considerable amount of money is lost annually due to diseases and abnormalities detected during meat inspection in abattoirs. The annual financial losses due to condemnation of carcasses and organs in this study were estimated to be 32500 USD. This study revealed that the main cause of organ and carcass condemnation in slaughtered sheep and cattle in the northern part of Palestine were parasitic infestations and bacterial/viral infections respectively. To eliminate/reduce parasitic infestations, regular deworming of animals should be practiced. In addition, a humane method to eliminate stray dogs, which are the main cause of these parasitic infestations, should be implemented. Vaccination and good management can prevent the bacterial and viral infections.

## DECLARATIONS

### Acknowledgments

The author gratefully acknowledges Mr. Raef Dwekat and Vet. Khalil Noori at the Nablus Municipal Slaughterhouse for their assistance in collecting data for this investigation.

### Competing interests

The author declared that had no competing interests.

### Consent to publish

The author agrees to publish this paper in the journal of World's Veterinary Journal.

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