2022

Vol.7 No.12:176

Prevalence of Conditions that Cause Carcass and Organ Condemnation and Associated Financial Loses in Kisii County, Kenya

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Received date: November 14, 2022, Manuscript No. IPJPM-22-14843; Editor Assigned date: November 17, 2022, PreQC No. IPJPM-22-14843 (PQ); Reviewed date: November 28, 2022, QC No. IPJPM-22-14843; Revised date: December 08, 2022, Manuscript No. IPJPM-22-14843 (R); Published date: December 15, 2022, DOI: 10.36648/2572-5483.7.12.176

Citation: Osoro MA, Ombui JN, Gathura PB, Mwangi WE (2022) Prevalence of Conditions that Cause Carcass and Organ Condemnation and Associated Financial Loses in Kisii County, Kenya. J Prev Med Vol.07 No.12:176.

Abstract

A number of zoonotic diseases are transmitted through meat infected and or contaminated with zoonotic disease pathogens. Meat inspection is a meat quality management system that aims to prevent zoonotic disease transmission and production of safe meat for human consumption. During routine meat inspection, carcasses and organs not fit for consumption due to various reasons are identified and condemned and thereafter destroyed to prevent them from reaching the consumer. This condemnation however account for the financial losses incurred by livestock farmers and traders. A retrospective study was conducted in Kisii County to determine the prevalence of conditions causing carcass and organ condemnation and the associated financial losses. Data was acquired by scrutinizing meat inspection records in the period between January 2004 to December 2014. Average annual financial losses were estimated using annual average number of animals' slaughtered, annual rate of organ condemnation and average price of the various organs.

The meat inspection records in the period between 2004-2014, indicated that, a total of 108,622 animals were slaughtered in abattoirs within Kisii County, of which 45.6% (49,481) were cattle, 43.1% (46,802) were goats and 11.4% (12,339) were sheep. A total of 3,245 whole carcasses and 49,870 organs were reported to have been condemned. Out of the 3,245 condemned whole carcasses, 1,478 were from cattle, 1,399 from goats and 369 were sheep. Of the 49,870 condemned organs, livers accounted for 40.5% (20,197), lungs, 38.7% (19,317), kidneys, 8.7% (4,315), intestines and stomachs 7.9% (3,919), hearts 3.3% (1,643) and heads and tongues 0.96% (479). The main reason for liver condemnation across the three species was cirrhosis and degeneration, 48.1%, inflammation, 25%, Stilesia hepatica 12.6% and telangiactasis (11%). Lungs were mainly condemned due to abscesses (32.5%), pleurisy (22.5%) and pneumonia (15.2%), kidneys due to hydronephrosis 34.1% nephritis 26.1% and inflammation, 24.4%. Head and tongue due to Cysticercus bovis 58.9%, actinomycosis, 23.2% and hemorrhages, 18%.; while hearts were condemned due to hemorrhages, 60%, pericarditis, 25.7% and *Cysticercus bovis*, 7.2%. The total estimated financial loss attributed to carcass/organ condemnation in Kisii County between 2004 and 2014 was USD 57,1211.22 per month.

This study concluded that fascioliasis, *Stilesia hepatica* and inflammatory conditions remain the common causes of organ condemnation and considerable economic loss in Kisii County, Kenya.

Keywords: Carcass; Organ; Condemnation; Financial losses

Introduction

Kenya has a livestock population of 17.6 million cattle, 17.1 million sheep, 27.7 million goats and 2.97 million camels, and 0.65 million pigs and 33 million chicken [1]. The meat industry in Kenya is dominated by slaughter of cattle, sheep goats, pigs and chicken. Red meat from cattle, sheep and goats represents 80% of domestic meat consumption in Kenya, with cattle as the main source of red meat [2]. In 2009, cattle meat accounted for 73% of the total meat consumed by Kenyans [3]. The livestock population in Kisii County is about 286,000 heads of cattle, 84,462 goats, 31,420 sheep, 10,000 broiler poultry and 110,700 layers and over 1,000,000 indigenous poultry [4].

Meat is an essential source of protein in people's diet but can also be a vehicle for transmission of diseases to consumers the national annual per capita meat consumption stands at 16 kg, while the county has an estimated annual per capita beef consumption of 3.25 kg which is way far below the national average [5,6]. The meat consumed must be wholesome and safe to guaranteed public health. Meat inspection is an important activity that guarantees meat safety and safeguards public health by removing from the market meat that is affected with zoonotic disease conditions [7]. A number of disease conditions cause condemnation of carcasses and organs during meat inspection. The most common conditions causing carcass and organ condemnations include cysticercosis, hydatidosis, fascioliasis, tuberculosis, brucellosis, anthrax, foot and mouth

disease, rift valley fever, poor bleeding, pneumonia, abscesses, bruises and adhesions, contaminations and various inflammatory conditions. However, carcass and organ condemnations to ensure meat safety leads to huge financial losses to farmers and traders as no compensation are given to such condemnations [8-12]. Abattoir data on conditions causing carcass and organ condemnation at during meat inspection after animal slaughter is an excellent option for detecting diseases of both economic and public health importance, especially in ascertaining the extent to which man is exposed to certain zoonotic diseases, which is important in providing information on where and how to reduce the losses that may be caused by the various conditions [13-16]. In addition, it can be used to estimate the financial losses associated with carcass and organ condemnations [11]. Various studies in various parts of the world indicate that that the conditions affecting carcass and organ condemnation reflect the state of animal and zoonotic disease occurrence in the any specific country or region. The few studies done in Kisii on conditions of public health importance have indicated that there is a relatively high occurrence of zoonotic conditions with a high risk of infection to humans. This situation notwithstanding, few studies have been documented with regards to causes of condemnation of organs and carcasses in slaughterhouses in the county and the economic implication of these conditions. This study therefore aimed to identify disease conditions that cause carcass and organ condemnation which will reflect the extent of occurrence of these diseases in the areas of livestock origin and potentially in livestock and product destinations. The study also sought to identify the economic significance carcass and organ condemnations to farmers and livestock trader's stakeholders.

Materials and Methods

Description of the study area

The study was carried out Kisii County, one of the 47 counties of the republic of Kenya. The county is located in the Western Kenya region and is bordered by six Counties including Narok to the South, Migori to the West, Homa Bay to the North West, Bomet to the South East and Nyamira to the East. The County has mixed farming systems with cattle, goats, sheep, donkeys, poultry, pigs and rabbits as main livestock farming activities. It has six slaughterhouses and 20 slaughter slabs distributed in the nine sub-counties. Of these, cattle, goats, sheep and poultry are the most commonly slaughtered species for meat.

Data collection

Kisii County meat inspection records from January 2004 to December 2014 were scrutinized and data related to species slaughtered, carcass/organ condemned and conditions causing carcass/organ condemnation were extracted and recorded. The number and type of animal slaughtered per year, number of carcass and organ condemnation and reasons for condemnations were obtained from meat inspection records of each of the slaughterhouses in Kisii County.

Estimation of financial losses

Financial losses attributed to carcass and organ condemnation was estimated using a formula ALC=CSR \times LC \times P, previously adopted by [16,17], where:

ISSN 2572-5483

- ALC is the average annual financial loss from condemnation.
- CSR is the mean annual cattle/sheep/goats slaughtered in Kisii abattoirs in the study period 2004-2014.
- LC is the mean local cost of a cattle/sheep/goat carcass/organ in Kisii County between 2004-2014. The mean cost of carcass and organs was determined based on average market price as informed by abattoir personnel and meat traders.
- P is the carcass/organ condemnation rate in Kisii County between 2004-2014.

Results

Prevalence of conditions causing carcass/organs condemnation in Kisii County

In the period between 2004-2014, a total of 108,622 animals were slaughtered in abattoirs within Kisii County. Out of the 108,622 animals, 45.6% (49,481) were cattle, 43.1% (46,802) were goats and 11.4% (12,339) were sheep. Within the same study period, a total of 3,245 whole carcasses and 49,870 organs were reported to have been condemned. Out of the 3,245 condemned whole carcasses, 1,478 were from cattle, 1,399 from goats and 369 were sheep. The prevalence of specific organs condemned condemnation included liver, 40.5% (20,197), Lungs 38.7% (19,317), kidneys 8.7% (4,315), Intestines and stomach 7.9% (3,919), Hearts 3.3% (1,643) heads and tongues 0.96% (479) heads and tongues (**Figure 1**).



Liver cirrhosis due to fascioliasis and degenerative conditions accounted for 48.1% of causes of liver condemnation across the three species. This was followed by inflammation of liver capsule (25.0%), *S ilesia hepa ica* (12.6%) and telangiectasis (11.0%). Lung condemnations were mainly due to abscesses (32.5%), pleurisy (22.5%) and pneumonia (15.2%). While kidneys were mainly condemned due to hydronephrosis 34.1% (1471/4315), nephritis 26.1% (1124/4315) and inflammation of capsule 24.4% (1053/4315). The prevalence of other conditions that caused intestines, stomach, hearts, head and tongue to be condemned are shown in Table 1 below.

| Condemned organ (s) | Conditions causing organ condemnation | Number of organs condemned | Percentage (%) of total condemnation |
|-----------------------------------|---------------------------------------|----------------------------|--------------------------------------|
| Liver N=20,197 | Liver cirrhosis & degeneration | 9705 | 48.1 |
| | Inflammation | 1540 | 25.0 |
| | Stilesia hepatica | 2553 | 12.6 |
| | Telangiectasis | 225 | 11.0 |
| | Liver flukes | 631 | 3.1 |
| | Abscess | 19 | 0.1 |
| | Hydatid cysts | 16 | 0.1 |
| | Parasitic cysts | 8 | 0.04 |
| Lungs | Abscess | 6278 | 32.5 |
| N=19,317 | Pleurisy | 4344 | 22.5 |
| | Pneumonia | 2928 | 15.2 |
| | Emphysema | 1965 | 10.2 |
| | Congestion | 1423 | 7.4 |
| | Parasites | 1262 | 6.5 |
| | Echinococcosis | 1117 | 5.8 |
| Kidneys | Hydronephrosis | 1471 | 34.1 |
| N=4,315 | Nephritis | 1124 | 26.1 |
| | Inflammation of capsules | 1053 | 24.4 |
| | Hemorrhages | 624 | 14.5 |
| | Infarcts | 43 | 1 |
| Intestines and stomach N=3,919 | Pimply gut | 1684 | 43.0 |
| | Hemorrhages | 1460 | 37.3 |
| | Enteritis | 324 | 8.3 |
| | Parasites | 265 | 6.7 |
| | Infarcts | 186 | 4.8 |
| Hearts N=1,643 | Hemorrhages | 988 | 60.1 |
| | Pericarditis | 422 | 25.7 |
| | Cysticercus bovis | 118 | 7.2 |

 Table 1: Incidence rate of various conditions that contribute to organ condemnation in slaughterhouses in Kisii County.

| | Emphysema | 73 | 4.4 |
|--------------------------|-------------------|-----|------|
| | Congestion | 42 | 2.6 |
| Head and tongue N=479 | Cysticercus bovis | 282 | 58.9 |
| | Actinomycosis | 111 | 23.2 |
| | Hemorrhages | 86 | 18.0 |
| | Abscess | 1 | 0.2 |

Financial losses attributed to condemnation of carcasses/organs in Kisii County

The total estimated financial loss attributed to carcass/organ condemnation in Kisii County between 2004 and 2014 was USD 571,211.22 per month. The highest financial losses occurred in the 2006 with the least losses being observed in the year 2010. Economic losses attributed to condemnation of carcasses/organs were bovine USD 97,431.20, goats USD 92,089.40 and sheep USD 24,357.30. Losses due to condemnation of the liver were

USD 213.66 which accounted for 37.4% of the total losses in 10 years. Condemnation of lungs led to estimated loss of USD 192,237 which represented 33.7% of total losses. Estimated financial losses per condemned organ are summarized in **Table 2** below. Overall, the conditions that resulted into highest financial losses were congestion of the heart (USD 72,011), liver cirrhosis (USD 50,265.85), inflamed liver capsule (USD 427,513.67), *S ilesia hepa ica* (USD 42,705.93), congestion of the lungs (USD 41,039) and lungs emphysema (USD 41,039).

Table 2: Estimated economic loss due to condemnation attributed to specific conditions in slaughterhouses in Kisii County between 2004-2014.

| Condemned organ and attri -buted 10-year total loss | Condition causing condemna -tion of an organ | Estimated 10 year loss due to a specific condition (KES) | Estimated 10-year loss due to a specific condition (USD) (1\$=KES 100) |
|--|---|--|--|
| Whole carcass | Incomplete bleeding* | 30,01,427.89 | 30,014.28 |
| KES 3,001,427.89 | | | |
| Head and tongue | Abscess | 6,75,404.06 | 6754.04 |
| KES 1,865,307.87 | Actinomycosis* | 5,08,086.44 | 5080.86 |
| | Cysticercus bovis | 6,45,651.20 | 6456.51 |
| | Cysticercosis | 36,166.17 | 361.66 |
| Liver | Abscess | 1,03,521.85 | 1035.21 |
| KES 21,366,449.69 | Cirrhosis [*] | 50,26,585.05 | 50265.85 |
| | Flukes | 37,16,645.15 | 37166.45 |
| | Echinococcosis | 9,27,997.03 | 9279.97 |
| | Inflamed capsule | 42,75,136.66 | 42751.37 |
| | Stilesia hepatica | 42,70,591.31 | 42705.91 |
| | Telengectasis | 30,45,972.64 | 30459.73 |
| Lungs | Abscess | 31,00,872.61 | 31008.73 |
| KES 19,223,698.3 | Congestion* | 41,03,887.44 | 41038.87 |

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| | Emphysema [*] | 41,03,887.44 | 41038.87 | |
|---|------------------------|--------------|----------|--|
| | Parasites | 19,81,825.32 | 19818.25 | |
| | Pleurisy | 23,67,092.69 | 23670.93 | |
| | Echinococcosis | 22,99,135.55 | 22991.36 | |
| | Pneumonia | 12,66,997.25 | 12669.97 | |
| Stomach&intestines | Enteritis | 3,58,658.60 | 3586.59 | |
| KES 2,132,001.48 | Hemorrhages* | 8,86,671.44 | 8866.71 | |
| | Pimply gut* | 8,86,671.44 | 8866.71 | |
| Kidneys | Hydronephrosis | 2,90,654.04 | 2906.54 | |
| KES 1,573,405.78 | Hemorrhages* | 5,15,390.75 | 5153.91 | |
| | Infarcts | 5,15,390.75 | 5153.91 | |
| | Nephritis | 93,719.95 | 937.2 | |
| | Inflamed capsule | 1,58,250.29 | 1582.5 | |
| Heart | Hemorrhages | 2,38,301.62 | 2383.02 | |
| KES 7,958,866.09 | Cysticercus bovis | 1,85,157.72 | 1851.58 | |
| | Pericarditis | 1,85,157.72 | 1851.58 | |
| | Empysema | 1,49,138.17 | 1491.38 | |
| | Congestion* | 72,01,110.86 | 72011.11 | |
| Note: * Indicate conditions that led to highest financial loss per condemned organ. | | | | |

Discussion

Conditions causing carcass and organ condemnation

Condemnation of various organs in the study area was attributed to different conditions. Whole carcass condemnation was mainly due to improper bleeding, this finding was partly in agreement with a study by Yesihak and Webb [10] who found the main causes of partial condemnation of carcasses to be bruising (34.11%), poor bleeding (25.59%) contamination (12.58%) and adhesion (9.37%). On the other hand, condemnations of specific organs in this study were found to be due to various causes. Liver condemnation was found to be mainly due to fascioliasis, liver degeneration, inflammatory conditions, Stilesia hepatica and hydroneprosis. The leading cause of condemnation of lungs was inflammatory conditions including pleurisy and pneumonia (37.6%) and abscesses (32.5%). These causes of organ condemnation were similar to various findings found in Ethiopia where Stelesia hepatica, pneumonia, pericarditis and nephritis were found to be the main causes for goat and sheep organs condemnation in Bishoftu Elfora export abattoir [18]. However, they differed with finding of a study by Yesihika and Webb who found the main causes of condemnations of livers to be fasciola (29.74%), and lungs to be due to hydatid cysts (23.01%) and pneumonia (22.68%) [10].

The findings in this study were also not in agreement with a study done by Alembrhan and Haylegebriel [19] in Ethiopia who found hydatidosis to be the leading cause of lung condemnations in slaughter house in northern Ethiopia. 37.6% of lung condemnation was attributed to inflammatory conditions which were much lower than that documented at 60%. In another study in southern Ethiopia, which differed slightly with the findings in Kisii County, the major causes of condemnation in cattle carcasses were fascioliasis, hydatidosis, emphysema and pericarditis [18]. A study by Tembo and Nonga [20] in Dodoma, Tanzania documented hydatidosis, cysticercosis, fascioliasis and tuberculosis as major causes of organ condemnation. A study in Kisumu, Kenya between 2003 and 2008 found out that livers and lungs were condemned mainly due to parasitic conditions including fascioliasis, cysticercosis, cystic echinococcosis, Stilesia hepatica [9]. The

main causes of liver condemnations in animals slaughtered in the County were: Degenerative conditions accounting for about 48%, inflammatory 25% and Stilesia 12%. These findings did not agree with the studies done by Alembrhan and Haylegebriel; Abunna and Hordofa, in Ethiopia who reported hydatidosis as the most common cause of liver condemnations [19,21]. The incidence rate of *Stilesia hepatica* was also much lower compared to that recorded in Ethiopia by Mandefro, et al. who recorded an incidence rate of about 38.3% [18].

In the current study, hydronephrosis was found to be the leading cause of condemnation of kidneys. Other reported causes of kidney condemnations in Kisii county included capsular inflammation, hemorrhages and infarcts had not been reported before. These findings were not in agreement with the report by Tembo and Nonga in Dodoma Tanzania who cited parasitic conditions and congenital cysts as the leading causes of kidney condemnations. Additionally, a study by Mandefro, et al. in Ethiopia concluded that nephritis contributed to 35.3% of kidney condemnations, which was much higher compared to the current report that found out that nephritis accounted for 26.5% of kidney condemnations [18,20]. The main causes of condemnations of kidneys, hearts, tongue and spleens were nephritis (10.91%), poor bleeding (20.83%), abscess (4.71%) and splenitis (2.74%), respectively, while heads were condemned mainly due to poor bleeding (18.77%) and bruising (17.05%) [10].

This study partially agreed with studies done in Ethiopia, Tanzania and Kenya on causes of heart condemnation. Of all 1643 hearts condemned in Kisii County in the period 2004-2014, the two leading causes were hemorrhages (60.13%) and pericarditis (25.69%). A study done in Ethiopia by Mandefro, et al. attributed pericarditis to condemnation of 54.3% of hearts. Parasitic conditions such as *Cysticercus bovis* caused higher rate (7.18%) of condemnation of heart in the current study than the 4.35% reported elsewhere [18,19]. The finding that pimply gut was leading causes of condemnation of stomachs and intestines in Kisii County was in agreement with. However, the rate of condemnation due to pimply gut was 7 times higher in Kisii County than in Dodoma [20]. Other conditions observed in Kisii County such as: enteritis, infarcts and parasites were not highlighted in other similar studies.

A study by Mohammed, et al. in Ghana revealed that one whole carcass (0.007%) was condemned due to Lumpy Skin Disease (LSD) with 376 organs condemned (16). Tuberculosis (TB) caused the highest number of organ condemnation with 40.63%, followed by Contagious Bovine Pleuropneumonia (CBPP) (28.53%), abscesses (10.66%), fracture (5.19%), enteritis (3.75%), LSD (2.6%), mange (1.7%), mastitis (1.7%), jaundice (1.15%) and gangrene (1.15%).

Financial losses attributed of condemnation of carcass and organs

Estimated losses due to carcass and organ condemnation in Kisii County ranged from USD 50,265.85 due to liver cirrhosis to USD 361.66 due to *Cysticercus bovis* infestation of head and tongue in the study period January 2004 and December 2014.

This study estimated that Kisii County lost about USD 571,211.57 annually from organ and carcass condemnations. This was higher than the estimated losses of USD 24,323.49 recorded in Soddo Municipality, Southern Ethiopia [21]. However, higher (USD 79,894.58) losses were recorded in an export abattoir in Ethiopia than that recorded in Kisii County. Similarly, Alembrhan and Haylegebriel estimated an annual loss of USD 1,083.83 for an abattoir in Adigrat in Ethiopia [18,19].

A study by Kanyari, et al. in Kisumu, Kenya in 2007 and 2008, estimated the total financial loss from liver fluke infections to be USD 12,034 and USD 13,413 respectively. This was almost half of the estimated losses in this current study of USD 21,664.50 [9]. The total estimated loss attributed to organ condemnations as a result of Cys icercus bovis in Kisii County was USD 8,308.00 which was relatively lower than USD 12,672.96 from condemnations due to Cys icercus bovis and USD 40,135.00 due to hydatidosis and fascioliasis, reported by Efrem, et al. [22]. In a study done in Adigrat, Ethiopia, the annual loss from liver cirrhosis was estimated at USD 526 and only USD 55.25 worth of kidney was condemned as a result of hydronephrosis. This loss was much lower compared to USD 50,265.85 and USD 2906.54 estimated annual loss due to liver cirrhosis and kidney hydronephrosis in Kisii County. In another study done in semiarid coastal areas of Kenya, S ilesia hepa ica accounted for an estimated loss of USD 14,807.80 over a period of 16 years which was equivalent to an annual estimated loss of USD 925.49 [23]. A study by Yibar, et al. in Bursa Turkey showed that financial loss due to organ and carcass condemnations at two abattoirs studied for a period of six-months was USD 245,483 [15]. In sheep, the six-month financial loss attributed to organ condemnation due to fasciolosis and hydatidosis was estimated to be USD 3281 and USD 4015 respectively. In cattle, losses due to fasciolosis and hydatidosis were estimated as USD 4042 and USD 12,321 respectively. An estimated annual loss of USD 42,705.91 as a result of S ilesia hepa ica infection of goat and sheep liver condemnations was observed in Kisii county which was many times more than the losses recorded in semi-arid coastal areas of the country.

Conclusion

This study concluded that condemnation of whole carcass was rare in Kisii County and when it occurred, the main cause was usually incomplete bleeding. On the other hand, livers, lungs and kidneys were the most commonly condemned organs in the county. The main reasons for liver condemnation across the three species being fascioliasis, degeneration, *S ilesia hepa ica* and telangiactasis. Lungs were mainly condemned due to abscesses, pleurisy and pneumonia and kidneys due to hydronephrosis and nephritis. Head condemnations which was mainly due to *Cys icercus bovis* actinomycosis and hemorrhages constituted <1% of all organ condemnations. Condemnation of carcasses and organs in abattoirs in Kisii County was associated with high economic losses, which was estimated to be around USD 571,211.57 annually. The losses were mainly attributed to condemnation of liver, lungs and kidneys.

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Recommendations

The study recommends regular deworming of animals to control fascioliasis and avoid grazing in marshy areas to avoid contact with snails. This should also be complimented with prompt treatment of sick animal too prevent inflammation and abscess formation. Additionally, the study recommends further training and continuous education of farmers on proper animal husbandry practices for improved animal health.

Acknowledgement

I would like to sincerely thank The University of Nairobi and Faculty of Veterinary Medicine for giving me an opportunity to study which went a long way towards making my work a success. I also wish to thank my supervisors (Prof. J. Ombui and Dr. P. Gathura) for their sound counsel, who despite their busy scheduled spared time to guide me and advise me throughout this study. I cannot forget the great technical and logistical support accorded to me during my work by the Kisii County director's office. It went a great deal towards the success of this research.

I deeply thank the farmers and member of their households that took part in this study. Without you and your good will, this work would have been impossible. Thank you very much. Also the team of enumerators and animal health assistants who worked and walked with me in the difficult terrain to collect this data, much gratitude goes to you. In conclusion, my deepest gratitude to my family and close friends for their prayers and priceless support offered to me during this period.

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