

Causes of Liver and Lung Condemnation among Apparently Healthy Slaughtered Sheep and Goats at Luna Abattoir, Modjo, Ethiopia

Mesfin Gezu and Mekonnen Addis

School of Veterinary Medicine, College of Agriculture and Veterinary Medicine,
Jimma University, P. O. Box 307, Jimma, Ethiopia

Abstract: Each year a large loss from slaughtered animals results due to condemnation of edible organs such as liver and lung. Therefore, this study was conducted from November 2013 to March 2014 at Luna export abattoir with the aims to identify and determine the major health problems that cause liver and lung condemnation among sheep and goats slaughtered in the abattoir. Standard ante-mortem and post-mortem inspection procedures were followed throughout the study. Ante mortem inspection was carried out in the lairage and abnormalities encountered were recorded, followed by postmortem examination through their identification number to detect gross abnormalities and aesthetic reasons that rendered liver and lung to be rejected from local and international market. During the study a total of 501 goat and 319 sheep liver and lung were examined. The study revealed that in both species 548(66.8%) livers and 522(63.6%) lung was rejected due to various causes. *S. hepatica* 167 (20.4%) and hepatitis 162(19.8%) was the highest cause of liver condemnation in both species. As well as Pneumonia 246(30.0%) and Lung worm 93(11.3%) was the main cause of lung condemnation. Liver condemnation due to parasites such as *S. hepatica*, fasciola and hydatid cyst contributed to 167(20.4%), 41(5.0%) and 4 (0.5%) respectively of the total condemned liver of Shoa. Additionally emphysema and hemorrhage contributed to 91(11.1%) and 44(5.4%) for cause of lung condemnation respectively. However, there was no statistically significance difference ($p>0.05$) for all causes of liver condemnation between young and adult but, there was statistically significance difference ($p<0.05$) for cause of liver condemnation between sheep and goats. This study has a paramount importance for the country by providing data in monitoring animal disease conditions and management practices which lead to the condemnation of organs and carcasses during slaughtering of animals. So as to reduce these losses such recommendations are mentioning: Immediate, safe and controlled elimination of all condemned abattoir materials and contaminated offal and heads as dog's feed should be prohibited by law; different workshops should be prepared to enhance the awareness of the animal attendants, farmers, customers, abattoir workers and butchers pertaining the public health significance of the diseases and proper disposal of condemned offal's and carcasses.

Key words: Liver • Lung • Condemnation • Sheep • Goats • Luna Abattoir • Modjo • Ethiopia

INTRODUCTION

Sheep and goat population in Ethiopia is approximately 25.98 and 21.96 million, respectively which cover over 30% of all domestic meat production of the country. They generate cash income from export of meat, edible organs, skins and live animals. There is also a high domestic meat demand from these animals, particularly during religious festivals. Even though this sub-sector contributes much to the national economy, its

development is hampered by various constraints. These include endemic animal diseases, poor nutrition, poor husbandry, poor infrastructure and shortage of trained labor and lack of government policies [1].

Each year a large loss results from death of animals and weight loss during transportation; and condemnation of edible organs and carcasses at slaughter. Abattoir meat inspection is essential to remove gross abnormalities from meat and its products, to prevent distribution of contaminated meat and to assist detecting and eradication

Corresponding Author: Mekonnen Addis, School of Veterinary Medicine, College of Agriculture and Veterinary Medicine, Jimma University, P.O. Box: 307, Jimma, Ethiopia, Cell: +251-912112251.

of certain livestock diseases. More specifically, ante mortem inspection attempts to avoid introduction of clinically diseased animals in to slaughterhouse and also serves to obtain information that will be useful in making sound post mortem inspection. Likewise, post mortem inspection is the centre around which meat hygiene revolves since it provides information essential for evaluation of clinical signs and pathological process that affect the wholesomeness of meat [2].

Currently, some modern export abattoirs are established in Ethiopia and are exporting sheep and goats' meat to Middle East countries such as Saudi Arabia and United Arab Emirates. There is a high demand for live animals as well as meat from small ruminants by consumers in these countries. For example, the country exported 12,000 tons of small ruminant meat in 2005/06, such export market may be influenced by the quality of meat produced especially from diseases point of view. Parasitological and/or pathological abnormalities that occur in edible organ and carcass of small ruminants can affect the meat export market of these animals either directly or indirectly by causing rejection of carcass/organs by the importer Countries due to zoonoses threat and aesthetic reasons [3].

Various studies [4-8] were carried out in the country in this regard to know the causes. However, these studies did not consider losses due to partially condemned of liver and lung. Therefore, the objectives of this study were therefore to identify the significant causes of liver and lung condemnations and identify the risk factor that causes liver and lung condemnation among sheep and goats slaughtered at Luna slaughter house

MATERIALS AND METHODS

Study Area: The study was conducted from November 2013 to March 2014 at Luna export abattoir which is located in Modjo town. Modjo town was the centre of luma district, East Shoa Zone of Oromia Regional State, Central Ethiopia. It is located 70 km southeast of Addis Ababa 8° 35'N and 39°10' E at an altitude of 1777-1880 m.a.s.l. The average maximum and minimum temperature is 28° C and 18° C, respectively. The luna export slaughter house was established in 2003 and located in Modjo town with 50,000 square meters of area. This is one of the abattoirs which export meat to Saudi Arabia, Turkey, Egypt and United Arab Emirates [9].

Study Animals: In both the retrospective and active abattoir survey, the animals included in the study were male sheep and goats as female animals were not

slaughtered at the abattoir. These animals were brought from different parts of the country including Arsi, Bale, Afar, Wello, Borena, Metahara, Konso, Harar and Somale to the abattoir for slaughtering. They were transported to the abattoir using vehicles and on foot.

Sample Size Determination: Sample size was calculated using the formula given by Thrusfield[10] with 50% expected prevalence, 95% confidence interval and 5% desired absolute precision. Accordingly, the sample size was determined to be 384. However, as can be understood from the retrospective record, large number of animals were slaughtered at the abattoir and thus, the sample size was increased to 820 animals (almost more than two times of calculated sample size) to increase precision. To calculate the sample size, 50% prevalence of major causes of liver and lung condemnation in small ruminants at luna export slaughter house, 95% Confidence level and 5 % of desired absolute precision ($d=0.05$) were used.

$$n = \frac{1.96^2 * P_{exp} (1-P_{exp})}{d^2}$$

Where, n = required sample size, p_{exp} = expected prevalence, d^2 = desired absolute precision at 95% confidence level. According to the above formula a minimum of 384 small ruminants are intended to be sampled. But to increase our precision the sample size was increased to 820. Hence, 319 sheep and 501 goats' samples were used.

The sampling procedure was carried out using systematic random sampling as indicated by [10] in such a way that sampling units were selected at equal intervals with the first animal being selected randomly.

Study Types and Methodology: A cross-sectional type of study was used. Ante mortem inspection, pre-slaughter examinations of small ruminants were conducted at lairage. Various information concerning age, body condition score and origin of each study animals were properly recorded. Detailed post mortem examinations of the liver and lung were carried out and pathological lesions were differentiated and judged in accordance with the guideline for meat inspection for developing countries [2].

The results were recorded and the decisions were classified as totally approved, partially approved, conditionally approved as fit for human consumption and totally condemned as unfit for human consumption. Organ namely liver was approved for export only if it was totally free of any abnormalities; otherwise, if any lesion irrespective of its size and coverage was observed, the

organ were totally condemned from export. Some of these organs that were with limited (minor) abnormalities were sold on the domestic market while the rest organs with serious abnormalities were condemned [1].

The age grouping was done based on dentition standard given by Vatta [11]. In this study, animals were grouped in to young, which have not erupted permanent incisor teeth and one pair of permanent incisors (i.e. <1 year to 1½ years (for sheep) and <1 year to 2 years (for goats)). Those having two pairs and above permanent teeth (i.e. =1½ years (for sheep) and =2 years (for goats) were grouped as adult.

Body condition scoring was also carried out based on the handbook given by Ethiopian Sheep and Goat Productivity Improvement Program, ESGPIP [12]. Additionally, general behavior of the animals, nutritional status, cleanliness and sign of diseases and abnormality of any type were registered according to the standard ante mortem inspection procedures [13] and animals that were fit for human consumption were allowed for slaughter. All the 820 small ruminants that were examined by ante mortem inspection were also thoroughly examined during post mortem inspection.

Abattoir Survey

Ante Mortem Inspection: Pre-slaughter examinations of small ruminants were conducted in the lairage by grouping the animals based on species and place of origin. Ante mortem inspections were conducted on individual animals, while the animals were entering into the lairage and after they entered in to the lairage in mass. Both sides of the animals were inspected at rest and in motion. Moreover, the general behavior of the animals, nutritional status, cleanliness and sign of diseases and abnormality of any type were registered according to the standard ante mortem inspection procedures [13]. Following the judgments, animal fit for human consumption was allowed for slaughter [1].

Postmortem Inspection: During postmortem inspection liver and lungs were thoroughly inspected by visualization, palpation and making systemic incisions where necessary for the presence of cysts, parasites and other abnormalities. Pathological lesions were differentiated and judged according to guidelines on meat inspection for developing countries and the results were recorded and the decisions at postmortem inspection are classified in to the following categories of judgment such as approved as fit for human consumption, conditionally

approved as fit for human consumption, totally condemned as unfit for human consumption and partially condemned as fit for human consumption [1].

Statistical Analysis: The collected data from records and from the active abattoir survey were entered in to excel spread sheet 2007. For the data from the post mortem inspection, descriptive statistics were used to determine liver and lung condemnation rates, defined as proportion of cause of condemned to the total number of liver and lung examined. The data were thoroughly screened for errors and properly coded before subjecting to statically analysis and analyzed using the chi-square test according to species, age and cause of liver and lung condemnation of the animals. In all cases, the SPSS soft ware version 20.0 was used and the confidence level was held at 95% and the result were considered significant when $p < 0.05$.

RESULTS

The common causes of the losses in liver was found to be *Stilasia hepatica*, hepatitis, calcification, adhesion, cirrhosis and fasciola and in lung wre proved to be pneumonia, lungworm, emphysema and hydatid cyst respectively. *Stelasia hepatica* was the highest cause of liver condemnation in goats.

Cause of Liver Condemnation Between Species: Out of 501 goats and 319 sheep, 342 (68.2%) goats and 206(64.5%) sheep were affected by one or more of the identified different cause of liver disease, the overall condemnation of liver in goats was found to be higher (68.2%) than sheep (64.5%), Analysis of the data showed that there was statistical significant difference ($P < 0.05$) on liver condemnation between species (Table 1).

Out of the total livers condemned in both species, the principal causes of condemnation were *Stelasia hepatica* 146 (29.1%) and 21(6.6%) in goats and sheep respectively. Hepatitis, calcification, adhesion, facsiolosis, cirrhosis, jaundice and hydatid cyst contributed to liver condemnatyion in both species chronologically (Table 1). Lung condemnation between species

From total of inspected lung of goats and sheep, 324(64.6%) and 198(62.1%) were affected by different causes of lung diseases respectively (Table 2).

The major causes of lung condemnation were pneumonia comprising 30.3% and 29.5% in goats and sheep species, respectively (Table 5). Lung worm, emphesema, hemorrhage and hydatid cyst contributed to

Table 1: Distribution of Causes of liver condemnation between species

Species	Cause of liver condemnation							
	Stilesia Hepatica	Cirrhosis	Calcificatin	Fasciola	Jaundice	Adhesion	Hepatitis	Hydatid Cyst
Goats	146 (29.1%)	22 (4.4%)	44 (8.8%)	20 (4.0%)	3 (.6%)	32 (6.4%)	75 (15.0%)	0 (0%)
Sheep	21 (6.6%)	9 (2.8%)	38 (11.9%)	21 (6.6%)	1 (.3%)	25 (7.8%)	87 (27.3%)	4 (1.3%)
Total	167 (20.4%)	31 (3.8%)	82 (10.0%)	41 (5.0%)	4 (.5%)	57 (7.0%)	162 (19.8%)	4 (.5%)

$\chi^2 = 77.425$, P-value = .000

Table 2: Distribution of Causes of lung condemnation between species

Species	Cause of lung condemnation				
	Hydatid cyst	Emphysema	Hemorrhage	Lung worm	Pneumonia
Goats	24 (4.8%)	58 (11.6%)	30 (6.0%)	59 (11.8%)	152 (30.3%)
Sheep	23 (7.2%)	33 (10.3%)	14 (4.4%)	34 (10.7%)	94 (29.5%)
Total	47 (5.7%)	91 (11.1%)	44 (5.4%)	93 (11.3%)	246 (30.0%)

$\chi^2 = 4.450$, P - value = 0.616

Table 3: Association between age and liver condemnation

Cause of liver condemnation	Goats		Sheep	
	Adult	Young	Adult	Young
Stilesia hepatica	114(30.6%)	32(25.0%)	15(6.6%)	6(6.5%)
Cirrhosis	18(4.8%)	4(3.1%)	4(1.8%)	5(5.4%)
Calcification	30(8.0%)	14(10.9%)	27(11.9%)	11(12.0%)
Fasciola	15(4.0%)	5(3.9%)	14(6.2%)	7(7.6%)
Jaundice	3(.8%)	0(0.0%)	1(.4%)	0(0.0%)
Adhesion	24(6.4%)	8(6.2%)	22(9.7%)	3(3.3%)
Hepatitis	55(14.7%)	20(15.6%)	67(29.5%)	20(21.7%)
Hydatid cyst	0(0.0%)	0(0.0%)	4(1.8%)	0(0.0%)

$\chi^2 = 4.269$, P - value = .748 $\chi^2 = 12.638$, P- value = .125

Table 4: Lung condemnation between ages

Cause of liver condemnation	Goats		Sheep	
	Adult	Young	Adult	Young
Pneumonia	123(33.0%)	29(22.7%)	73(32.2%)	21(22.8%)
Lung worm	47(12.6%)	12(9.4%)	27(11.9%)	7(7.6%)
Emphysema	34(9.1%)	24(18.8%)	24(10.6%)	9(9.8%)
Hemorrhage	22(5.9%)	8(6.2%)	9(4.0%)	5(5.4%)
Hydatid cyst	21(5.6%)	3(2.3%)	17(7.5%)	6(6.5%)

$\chi^2 = 15.704$, p - value = .015 $\chi^2 = 6.847$, P - value = .232

(11.8%) and (10.7%), (11.6%) and (10.3%), (6.0%) and (4.4%) and (4.8%) and (5.2%) in goats and sheep species respectively. Analysis of the data showed that there was no statistical significant difference ($P > 0.05$) on lung condemnation between species.

Cause of Liver Condemnation Between Ages: Out of 820 goat and sheep, 600(73.1%) and 220(26.8%) were adult and young respectively. From 73.1% of adult and 26.8% of young examined 413(68.8%) adult and 135(61.3%) young were affected by different cause of liver disease.

Stilesia hepatica and hepatitis were the main cause of liver condemnation in both ages of species. From cause of liver condemnations, stilesia hepatica and hepatitis contributed 30.6% and 25.0% in adult and young of goats respectively (Table 3). There was no statistically significance difference ($p > 0.05$) on liver condemnation between age in both sheep and goats.

Cause of Lung Condemnation Between Ages: Out of lung examined in both ages, 397(66.1%) and 124(56.3%) lung of adult and young were affected by different causes of lung disease respectively. The main cause of lung condemnation in both ages was pneumonia and lung worm with followed by emphysema and hemorrhage (Table 4). There was no statistically significance difference ($p > 0.05$) for all causes of lung condemnation between age of both sheep and goat.

DISCUSSION

Meat inspection is commonly perceived as the sanitary control of slaughter animals and meat. The aim of 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 shall make sure that meat and meat products are safe and wholesome for human consumption [2].

The ante mortem and post mortem inspections were conducted in the abattoir for the purpose of screening and removing animal products with pathological lesions which were unsafe for human consumption and having poor aesthetic value. It was indicated that meat inspection

assist in monitoring diseases in the national herd and flock by providing feedback information to the veterinary service to control or eradicate diseases and to produce wholesome products and to protect public from zoonotic hazards [13].

Animals that showed signs of abnormality during ante mortem inspection were not immediately approved for slaughter, rather detained for further confirmatory diagnosis [14]. However, in certain conditions when the cases were not serious, “conditional approval” of the animal was passed as judgment and special attention was given to such animals during post mortem inspection. Lameness and respiratory disorders were relatively the highest abnormalities encountered during the ante mortem inspection. One of the causes of lameness was trauma caused by inappropriate vehicles and loading and off-loading negligence during transportation to market places and to the abattoir. Some vehicles were found with sharp materials that could hurt the animals and additionally there was carelessness during the loading and off-loading of the animals which could cause trauma. The respiratory signs such as presence of nasal discharge, coughing, salivation, sneezing was most probably related to stress due to lack of feed and water, immune suppression and overcrowding during transportation. All animals that passed ante mortem examinations were approved for slaughter and subjected to post mortem inspection and the organs and carcasses approved for consumption were exported to Saudi Arabia, United Arab Emirates, Turkey and Yemen as per the quantity demanded from these countries. The condemned organs having poor aesthetic value and pathologically unfit for human consumption were incinerated in the abattoir so as to prevent the public from zoonoses hazard and their distribution [4].

Different lesions of infectious and non-infectious cases including cirrhosis, nephritis, pericarditis, abscess and jaundice were the major causes for the condemnation of edible organs. Moreover, parasites namely *stilesia hepatica* and *fasciola* species were found to be the important causes of liver rejection from international market. Likewise, previous works [4-8] reported the importance of parasites as causes of organs/carcass condemnation resulting in higher financial loss.

The abattoir survey showed the rejection of significant number of livers were 544 (66.3%) in both species due to *Stelasia hepatica* (29.1%, 146/501) followed by hepatitis (15.0%, 75/501), calcification (8.8%, 44/501) and adhesion (6.4, 32/501) in goats. Getachew [4] also reported the importance of these abnormalities with

highest report of hepatitis (19.3%) followed by calcification (14.0%) and adhesion (6.1%). Similarly, high numbers of livers were condemned from sheep due to various reasons (such as hepatitis, calcification, adhesion, cirrhosis, *Stilesia hepatica*, fasciolasis, etc.)

From the total inspected lungs of goats and sheep in the current study, 64.6% (324/501) and 62.1% (198/319) were condemned, respectively, from being used as pet food. Even though lung was not exported for international market, it was examined for the purpose of breaking the transmission cycle of diseases and hence, 521(63.5%) lungs were condemned from local market based on any gross lesions. The reasons for this condemnation were pneumonia, emphysema, lungworm, hydatid cysts and hemorrhage. Similarly, pneumonia (13.3%, 17.3% and 22.6%) was the most important abnormalities encountered during the respective years of retrospective study. These were in line with the report of [15] that recorded significantly higher pneumonia proportion (31.0%) out of the pulmonary diseases. It was also reported as a principal cause of lung condemnation in central Ethiopia accounting for 42.1% [8].

Likewise, Lung worm (11.3%) was the second most important abnormalities next to pneumonia (30.0%) during the current active abattoir survey. The result could be attributable to stress factors including fatigue during long journey in search of pastures and exposure to polluted air in their environments [15, 16] or feed contaminated with moulds [13]. Although it is usually bacterial or viral in origin, penetration of the lung by a foreign body, adverse weather conditions or accidental inhalation of liquids can cause it. Likewise, massive infestations of the respiratory tract with ascarid larvae and lungworm might also be responsible for pneumonia [16].

CONCLUSION

In this study the condemnation of liver and lung were found to be very immense. Pneumonia, hepatitis, emphysema, calcification, *Stelasia hepatica*, lung worm, cirrhosis, adhesion and hydatid cyst were found to be major causes of liver and lung contamination in the abattoir. Hence, this study may be valuable for the country by providing data in monitoring disease conditions and management practices of animals that have public health hazard and aesthetic value. Therefore, awareness should be created for the animal attendants, farmers, customers, abattoir workers and butchers regarding the public health significance of diseases of animal origin and the related losses. The abattoir should

also take serious precaution regarding the selection of the animals for slaughtering and understanding of their origin so that such condemnation can be minimized. Furthermore, proper disposal of the condemned offal's should be carried out so that it is easier to break the cycle of pathogens.

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