

Major Disease That Cause Lung, Liver and Carcass Condemnation and Its Financial Loss at Modjo Modern Export Abattoir

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Abstract

A cross sectional study was conducted from November 2016 to April 2017 at Modjo Modern Export Abattoir. A total of 842 apparently health sheep and goats slaughtered at the abattoir were thoroughly examined during post mortem inspection to identify the major causes of liver, lung and carcass condemnation. An attempt was also done to estimate the associated direct financial loss of the abattoir due to rejection of liver and carcass from international markets and lungs from local markets. Post mortem inspection showed that 467 (55.5%) livers 341 (40.5%) lungs and 95 (11.3%) carcasses in the category of both age and species were condemned due to various gross pathological lesions and aesthetical values. The major causes of condemnation were *Cysticercus tenuicollis* (14.01%), *Stelasia hepatica* (11.87) and fasciolosis (5.9%) for liver, pneumonia (20.3%), adhesion (5.34%) and emphysema (4.5%) for lungs. Bruising 26 (3.08%), adhesion 25 (2.96%), jaundice 23 (2.73%) and pox like lesions 21 (2.49) were the major causes contributed to the carcass condemnation. The annual financial loss of the abattoir was estimated to be 1,565,883.2 USD. The result of this study revealed that the rate of carcass and specially organ condemnation in the abattoir was high and needs immediate preventive and control measures to be implemented.

Keywords: Abattoir, Condemnation, postmortem, Small ruminants

1. Introduction

The world human population is growing at faster rate than food production and this increase is mainly in developing countries which are failed to assure adequate food for their people. Developing countries have nearly two third of world's livestock population, but produce less than a third of worlds meat and fifth of its milk (FAO, 1995). The contribution of livestock to poverty alleviation and food security can be increased through high consumption of indigenous livestock, commercialization of production systems and giving much greater attention to livestock productivity and health including, post harvesting and marketing (Delgado *et al.*, 1999).

Africa has a population of 174 million goats and 205 million sheep representing approximately 31% and 17% of the world total, respectively (FAO, 1995). Within Africa, the distribution of small ruminants varies greatly, with a higher concentration in low lands than high lands. Small ruminants produce only about 16% of the world's total meat, despite their higher contribution to the total world livestock population. In Africa small ruminant contributes greater proportion of the total wealth of the poor families, that is because of the low input requirements such as low initial capital, fewer resources and limited maintenance cost (Gatenby, 1991).

Ethiopia owns large number of small ruminants which is estimated about 25.5 million sheep and 22.78 million goats (CSA, 2011). It is ecological diversity that makes Ethiopia home for large populations of different domestic animals with considerable contributions to the national economy. The livelihood of both rural and urban, or sedentary and pastoral communities in the country is, to a large extent, associated with various outputs drawn from this sector (EVA, 2004).

It is estimated that 84% of more than 70 million people live in rural areas and depend on agriculture for their livelihoods and the sector contributes 41.4% of the Gross Domestic Product of the country (World Bank, 2006). Small ruminants are found mainly in the low land agro-ecological zone which constitutes 65% of the area, where 25% sheep and close to 100% goat populations exist (PACE-Ethiopia, 2003).

Sheep and goats cover more than 30% of all domestic meat consumption and generate cash income from export of meat, edible organs, live animals and skin (Dechasa *et al.*, 2012). The main causes of organ condemnation during post mortem inspection in slaughter house are diseases originated by parasites, bacteria and viruses. Helminthes infection in sheep and goats are responsible for far greater loss in production and to meat industry than any other diseases. Its constraints to the livestock resources are in all areas of the world, particularly in tropics and areas where veterinary services, nutrition and sanitation standards are poor (Jobber *et al.*, 1996). Rampant animal diseases, limited facility and shortage of trained man power hampered the contribution and development of livestock sub sector to national economy (PACE-Ethiopia, 2003).

The primary aim of abattoir is to produce healthy meat, wholesome and clean products which are safe for human consumption (Cadmus, 2009; Gracey, 1999). It also provides information on the epidemiology of diseases on livestock to know to what extent the public is exposed to certain zoonotic diseases and estimate the financial losses incurred through condemnation of affected edible organs and carcasses. As meat is the main source of

protein to man, it should be clean and free from diseases of particular public importance such as, tuberculosis and cysticercosis. Carcass and organs are also condemned to break the chain of some zoonosis which is not transmitted to human directly through meat like hydatidosis and other important diseases of animals such as fasciolosis (Shegaw, 2008).

A thorough meat inspection procedure requires two steps, ante mortem and post mortem inspections. The importance of ante mortem inspection in the abattoir has long been recognized in an attempt to avoid the introduction of clinically diseased animals in to the slaughter hall and should be done within 24 hours of slaughter and repeated if slaughter has been delayed over a day (Gracy, 1986; Teka, 1997). Post mortem inspection is a screening or sorting process devoted to separate the normal from abnormal meat. A proper post mortem inspection is important to detect and eliminate abnormalities, including contaminations, thus ensuring that the hygiene of the meat fits the basic requirements for human consumption (Gracey, 1999; Van Longtestijin, 1993). Therefore, the objectives of this study are: to determine the significant causes of lung, liver and carcass condemnations and to estimate the magnitude of direct financial loss due to condemned organs and carcass at Modjo Modern Export Abattoir.

2. Materials and Methods

2.1 Study Area description

The study was conducted from November 2016 to April 2017 in the Modjo Modern Export Abattoir, center of lume district, Eastern showa administrative zone of Oromiya regional state, central Ethiopia. It is approximately 73 Kilometers south east of Addis Ababa at latitude and longitude of 8°35'N and 39°10'E respectively with an elevation of between 1788 meters and 1825 meters above sea level (CSA, 2005). The total area of lume district is 752 Km², of this 60Km² is covered by water. The climatic condition of the area includes high lands (dega, 30%), medium lands (woinadega, 45%) and low lands (kola, 25%). The altitude of the study area ranges from 1604 to 2364 meter above sea level having annual rainfall of 1200-3500 milliliters. The average maximum and minimum temperature is 28°C and 18° respectively. The livelihood of the people is mainly depends on the agriculture/mixed livestock and crop production. The livestock population of the study area includes cattle, sheep, goats and equine species (LDSP, 2007).

2.2 Study Animals

A total of 842 apparently healthy small ruminants (316 sheep and 526 goats) destined for slaughter in the abattoir were all males originated from different areas of the country including, Afar, Arsi, Bale, Borena, Jinka Meiso, Ogaden and Debub Omo.

2.3 Study Design and Sample Size determination

Cross-sectional study was conducted in shoats slaughtered in the abattoir from November 2016 to April 2017 to determine the gross pathological causes for condemnation of liver, lungs and carcass. In this study, sheep and goats were randomly sampled using systematic and grouped in to young (under 1 year of age in goats, and 1 year and 3 months in sheep) and adult (goats more than 1 year, sheep more than 1 year and 3 months), based on eruption of one or more teeth according to (Gatenby, 1991; Steel, 1996). Following the random sampling and grouping the shoats in to young and adult, ante-mortem and post-mortem examinations were carried in the lariate and slaughter hall respectively. Using simple random sampling methods and 95% confidence interval with required 5% precision, the sample size will be determined by the formula of (Thrusfield, 2007).

$$n = \frac{1.96^2 \times Pexp(1-pexp)}{d^2}$$

Where n- Required sample size

Pexp - Expected prevalence

d- Desired absolute precision, usually d is 0.05 at 95% confidence level and 5% expected error. Substituting the value in the formula the required sample size was calculated to be 384. However, in order to increase the precision, the sample size was increased to 842 samples.

2.4 Abattoir Survey

2.4.1 Ante-mortem Examination

Pre-slaughter inspection was carried out on individual shoats in the lariate by grouping the animals based on species age. The age grouping was performed based on arbitrary classification dentition. Those which have not erupted permanent incisor teeth, were classified as young, while those with one pair or more permanent incisor teeth were classified as adults (Gatenby, 1991; Steel, 1996).

2.4.2 Post Mortem Examination

During Post mortem inspection, Liver, lung and carcass were thoroughly inspected by visualization; palpation and making systematic incisions where necessary for the presence of cysts, adult parasites and other abnormalities

responsible for study organs and carcass condemnation and the result were recorded. Gross pathological lesions were differentiated and judged according to the guidelines on meat inspection for developing countries and classified, approved as fit for human consumption, conditionally approved as fit for human consumption, totally condemned as unfit for human consumption and partially condemned as unfit for human consumption (Kassa, 2012).

2.5 Assessment of direct financial losses

To calculate financial losses, affected organs (significantly liver) and carcasses rejected were considered. Partial approval was not applicable in the abattoir in case of international market, but practiced for local markets. Annual slaughter capacity of the abattoir was an important data from the retrospective record. Annual slaughter rate of the abattoir varies depending on the demand of customers and market. The financial losses due to rejection of organs (liver and lung) and carcasses were computed mathematically by the formula of Ogunrinade (1980), for liver, lung and carcass rejection as follows;

$$FL = \sum Srx * Coy * Roz$$

Where,

FL- Estimated annual financial loss due to condemnation of liver, lung and carcass from the international and local markets.

$\sum Srx$ - Annual sheep/goat slaughter rate of the abattoir

Coy- Average Cost of each sheep/goat liver, lung and carcass

Roz- Condemnation rates of sheep/goat liver, lung and carcass

2.6 Data management system and statistical analysis

The data collected by ant-mortem and post-mortem inspection were recorded and entered in to Excel spread sheet for the process of coding and validation. The Descriptive analysis were used on the raw data obtained from post mortem examination to determine the level of organs and carcass condemned under the consideration of total sheep and goats examined. The possible financial losses were also calculated.

3. Result

3.1 Abattoir Survey

A total of 842 shoats (316 sheep and 526 goats) were thoroughly inspected during ant-mortem inspection and subjected to post mortem examination. From the organs examined in both sheep and goats at post-mortem examination, 467 (55.5%) livers, 341 (40.5%) lungs and 95 (11.3%) carcasses were rejected due to gross abnormalities accordingly, as unfit for local and international markets (Table 1).

Table 1: Overall rate of liver, lung and carcass condemnation in slaughtered shoats

| Animals examined | | Total No. of shoats Slaughtered | Frequency of gross abnormalities and percentage of condemned organs and carcass | | |
|------------------|-------|---------------------------------|---|-----------|----------|
| | | | Liver | lungs | carcass |
| Goats | young | 211 | 85(40.3) | 66(31.3) | 19(9) |
| | Adult | 315 | 151(47.9) | 107(34) | 27(8.6) |
| | Total | 526 | 236(44.8) | 173(32.7) | 46(8.7) |
| Sheep | young | 119 | 78(65.54) | 61(51.3) | 19(15.9) |
| | Adult | 197 | 153(77.6) | 107(54.3) | 30(15.2) |
| | Total | 315 | 231(73.3) | 168(53.3) | 49(15.5) |

Out of total lungs inspected, 173 (32.9%) and 168 (53.2%) lungs in goats and sheep species respectively were condemned. Pneumonia was found to be a principal cause of lung condemnation in both species with the rate of 20.3% followed by adhesion, 5.3% and emphysema, 4.5%. However, statistically the frequency and rate of pneumonia observed in goats varies greatly within the age, 29 (13.74%) in young and 91 (17.3%) in adults. Similarly the frequency of pneumonia in adult sheep was higher 48 (24.36%) than young which was 32 (26.89%) but, the rate of rejection was found to be increased in young sheep. Except emphysema and marbling appearance in goats, all gross pathological lesions were more frequently observed in adults than in the young animals (Table 2).

Table 2: Causes of lung condemnation and its rejection rates in slaughtered shoats

| Gross abnormality | Frequency of gross abnormalities and percentage of lung condemnation | | | | | |
|---------------------|--|--------------|-----------|--------------|--------------|-----------|
| | Goats(n=526) | | | Sheep(n=316) | | |
| | Young(n=211) | Adult(n=315) | Total | young(n=119) | Adult(n=197) | Total |
| Adhesion | 11(5.2) | 15(4.76) | 26(4.94%) | 8(6.7) | 11(5.58) | 19(6) |
| Abscess | 2(0.94) | 4(1.26) | 6(1.14%) | 2(1.68) | 7(3.55) | 9(2.84) |
| Emphysema | 8(3.79) | 8((2.53) | 16(3) | 8(6.7) | 14(7.1) | 22(6.9) |
| Hydatid cyst | 2(0.94) | 6(1.9) | 8(1.5%) | 3(2.5) | 8(4) | 11(3.5) |
| Lung worm | 8(3.79) | 5(1.58) | 13(2.47%) | 4(3.36) | 7(3.55) | 11(3.5) |
| Marbling appearance | 6(2.84) | 7(2.2%) | 13(2.47%) | 4(3.36) | 12(6) | 16(5) |
| Pneumonia | 29(13.74%) | 62(19.68%) | 91(17.3%) | 32(26.89) | 48(24.36) | 80(25.3) |
| Over all | 66(31.27) | 107(33.96) | 173(32.9) | 61(51.26) | 107(54.3) | 168(53.2) |

Among the total livers condemned in both species, the leading causes were found to be parasitic infections such as, *C. tenuicollis*, *S. hepatica*, and fasciolosis with the rate of 118 (14%), 100 (11.87%) and 50 (5.9%) respectively. Other causes like Hepatitis, 45 (5.3%), Calcification, 40 (4.7%), Adhesion, 35 (4.1%), Jaundice, 31 (3.7%), Cirrhosis, 26(3%) and Abscessation, 22 (2.6%) were also contributed to the liver condemnation. Fasciolosis caused a statistically higher rate of liver condemnation in sheep (11.4%) than in goats (2.7%). Similarly calcification, 7.3% and 3.2%, hepatitis 7.6% and 4%, adhesion 6.3% and 2.8%, abscess 4.4% and 1.5%, cirrhosis 5% and 1.9% caused statistically higher losses in sheep than in goats respectively. However, there was great difference in the frequency of *Stelesia hepatica* between sheep and goats that was higher in goats than sheep. In general, livers of sheep examined were found to have higher gross pathological lesions than that of goats' liver (Table 3).

Table 3: Causes of liver condemnation and its rejection rates in slaughtered shoats

| Gross abnormalities | frequency of gross abnormalities and percentage of liver condemnation | | | | | |
|-----------------------|---|------------|-----------|--------------|------------|-----------|
| | Goats(n=526) | | | Sheep(n=316) | | |
| | Young(211) | Adult(315) | Total | Young(n=119) | Adult(197) | Total |
| Abscess | 2(0.9) | 6(1.9) | 8(1.5) | 3(2.5) | 11(5.6) | 14(4.4) |
| Adhesion | 4(1.9) | 11(3.5) | 15(2.8) | 4(3.4) | 16(8.1) | 20(6.3) |
| Calcification | 4(1.9) | 13(4.1) | 17(3.2) | 6(5) | 17(8.6) | 23(7.3) |
| Cirrhosis | 3(1.4) | 7(2.2) | 10(1.9) | 6(5) | 10(5) | 16(5) |
| <i>C. tenuicollis</i> | 34(16.1) | 38(12.1) | 72(13.7) | 21(17.6) | 25(12.7) | 46(14.5) |
| Fasciolosis | 5(2.4) | 9(2.9) | 14(2.7) | 12(10) | 24(12.3) | 36(11.4) |
| Hepatitis | 3(1.4) | 18(5.7) | 21(4) | 7(5.9) | 17(5) | 24(7.6) |
| Jaundice | 5(2.4) | 9(2.9) | 14(2.7) | 7(5.9) | 10(5) | 17(5.3) |
| <i>S. hepatica</i> | 25(11.8) | 40(12.7) | 65(12.3) | 12(10) | 23(11.7) | 35(11) |
| Over all | 85(40.2) | 151(47.9) | 236(44.8) | 78(65.5) | 153(77.6) | 231(73.1) |

The pathological lesions responsible for carcass rejection from international market were bruising, adhesion, jaundice and pox like lesions and ranked with the rate of condemnation as 26 (3%), 25 (2.9%), 23 (2.7%) and 21 (2.5%) respectively. The rate of carcass condemnation due to adhesion was showed statistically higher in the sheep (4.5%) than goats (1.9%). Similarly jaundice has caused significant losses in sheep (4.4%) than (1.7%) in goats (Table 4).

Table 4: Causes of carcass condemnation and its rejection rate in slaughtered shoats.

| Gross abnormalities /conditions/ | Frequency and percentage of carcass condemnation | | | | | |
|----------------------------------|--|--------------|---------|--------------|--------------|----------|
| | Goats(n=526) | | | Sheep(n=316) | | |
| | Young(n=211) | Adult(n=315) | Total | Young(n=119) | Adult(n=197) | Total |
| Adhesion | 2(0.9) | 8(2.5) | 10(1.9) | 4(3.4) | 15(5.6) | 15(4.7) |
| Bruising | 9(4.3) | 6(1.9) | 15(2.8) | 7(5.9) | 4(2) | 11(3.5) |
| Jaundice | 3(1.42) | 6(1.9) | 9(1.7) | 5(4.2) | 9(4.5) | 14(4.4) |
| Pox like lesions | 5(2.4) | 7(2.2) | 12(2.3) | 3(2.5) | 6(3) | 9(2.8) |
| Over all | 19(9) | 27(8.6) | 46(8.7) | 19(15.9) | 30(15.2) | 49(15.5) |

3.2 Assessment of Direct Financial loss

The average annual slaughtering rate of shoats at the Modjo Modern Export Abattoir was 500,000 to 650,000. From the total livers, lungs and carcasses inspected during the study period, 467 livers, 341 lungs and 49 carcasses where condemned due to gross pathological lesions and aesthetically unfit for human consumption. The price of liver, carcass and a piece of lung was 3.9 USD/kg, 4.9 USD/kg and 0.25 cents respectively and the direct annual

loss from local and international markets at the abattoir was estimated to be 1, 565, 883.2 USD (Table 5).

Table 5: Data and findings used in the study for financial loss assessment.

| Organs/carcass | Average annual slaughter rate of the abattoir | Average condemnation rate of the organs and carcasses | Average price of organs and carcass |
|----------------|---|---|-------------------------------------|
| Liver | | 467(55.5%) | 3.9USD |
| Lungs | 500,000 to 650,000 | 341(40.5%) | 0.25cents(locally) |
| Carcass | | 95 (11.3%) | 4.9USD |

4. Discussions

An important function of meat inspection in abattoir is to assist in monitoring diseases in the national herd and flock by providing feedback information to veterinary services, to control or eradicate diseases, producers, to produce wholesome products safely and to protect the public from zoonotic hazards (*Gracey et al.*, 1999).

The study revealed that parasites (*C. tenuicollis*, Fasciola and *S. hepatica*) are the principal causes responsible for the liver rejection in the abattoir. Losses from condemnation were assumed to occur since hepatic pathology is associated to infection that might have public health importance (*Budke et al.*, 2006) and aesthetic value. More than half of livers condemned due to helminthes. The rate of livers condemned in this study due to *S. hepatica* was lower than the study reported by *Mungube et al.* (2006), 28% in sheep and 22% in goats in Kenya, *Sisay et al.* (2007), 39% in sheep and 36% in goats in eastern part of Ethiopia. But the finding in this study is relatively in agreement with the report by *Jibat et al.* (2006), 9.5% in sheep and 12.1% in goats. Previous studies have also indicated a higher financial loss resulting from condemnation of edible organs and carcass due to helminthic infections (*Assefa*, 2005; *Jembere*, 2002; *Abdella*, 1994; *Ferede*, 1995).

The rate of liver condemnation due to fasciolosis was found higher in sheep than that of goats which could be due to their feeding way, where sheep are usually based on grazing having a great chance to get infected by the parasite and goats are less exposed to parasite (fasciolosis), because of their tendency to browse. In this study, the rate of livers condemned due to liver fluke infestation was 11.39% in sheep and 2.66% in goats which may indicate that sheep can acquire the infection in greater chance due to their grazing habit near to the ground. Another important parasite responsible for liver condemnation was *Cysticercus tenuicollis*. In this study the rate of liver condemnation due to *C. tenuicollis* were 14.5% in sheep and 13.68% in goats, which was less than the study reported by *Bekele et al.* (1988), 37.1% at Addis Ababa and relatively higher than those reported by, *Ezana* (2008), 9.6% in goats and 8.8% in sheep.

Out of the total lungs examined, 168(53.2%) and 173 (32.9%) of lungs were condemned due to gross pathological lesions in sheep and goats respectively. Of these lesions pneumonia was found as the leading cause for lung condemnation in both sheep and goats. This increased occurrence of pneumonia could be due to long distance transportation, suffocations in the vehicles, stress and immediate entering of shoats in to the slaughter house without taking rest. Bruising of animals during transportation, rough handling and improper slaughtering leads to partial approval (if minor) of carcass in the abattoir, hence not exported and supplied for local markets. Apart from financial losses due to bruising of carcass, animal welfares are violated by poor handling, overcrowding during transportation and excessive beating while driving the animals to the abattoir. Losses due to bruising in partially and totally condemned carcasses are more apparent (*Gracy et al.*, 1999). The organs (liver) and carcass fit to be passed (approved) for human consumption in the Modjo Modern Export Abattoir are exported and marketed in Dubai, Jidda and Saudi Arabia, whereas partially approved carcasses and livers are locally supplied for hotels and restaurants in Debre-Zeit and Addis Ababa. The rejected carcasses and organs due to poor aesthetic value that was unfit for human consumption and due to gross pathological lesions were incinerated in the abattoir. Since the abattoir is HACCP certified and export standard, its financial loss was relatively high because, rejected carcasses and livers unfit for international markets but fit for local markets were marketed with salvage value in cheap price at the abattoir for hotels and restaurants and lungs sold for use of pet animals.

5. Conclusion and Recommendations

Diseases, poor management and limited veterinary services are the principal concern to the livestock industry leading to extensive financial loss due to rejection of organs and carcass from international and local markets. Therefore, meat inspection as part of veterinary public health activities in the abattoir provides an excellent opportunity for detecting diseases of both economic and public health importance. According to the result of this study, helminthic infections in shoats, *Cysticercus tenuicollis*, *Stelasia hepatica* and Fasciola were the major causes of liver condemnation followed by hepatitis, calcification, adhesion, jaundice, cirrhosis and abscessation. Pneumonia, adhesion, emphysema, bruising and jaundice were the far greater causes for the respective organ and carcass to be rejected from local and international markets. Financial loss which were estimated to be 1,565,883.2 USD due to gross pathological lesions on livers, lungs and carcasses. The result of this study may reflect feedback

information to prevent and monitor diseases conditions and experience good management practices for small ruminants. So as to reduce these losses, the following are excellent mentioning:

- Various opportunities should be created to teach and enhance awareness among farmers, animal attendants and abattoir workers about public health importance (transmission and the life cycle of those helminthes), proper disposal of trimmed and condemned offal and carcass.
- Regular deworming of dogs and elimination of stray dogs (humane way) should be practiced).
- Avoiding poor management and promoting establishment of intensive farming of small ruminants has a worth concern.
- In the slaughter house, there should be clear line of demarcation between clean area and dirty area so as to reduce contamination of carcass and edible organs.

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7. Conflict of interest

The Authors declares that there is no conflict of interest

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