

A Study on the Major Causes of Liver Condemnation and Associated Financial Loss in Cattle Slaughtered at Debre Birehan Municipality Abattoir

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Abstract: A cross-sectional study was conducted from November 2015 to April 2016 in Debre Birehan municipality abattoir to identify the major cause of liver condemnation and to estimate the magnitude of direct financial loss due to liver condemnation. A total of 384 animals were examined by antemortem and postmortem examination. During antemortem examination abnormalities like; lameness 3(18.75%), skin scar 2(12.5%), rough hair coat 6(37.5%), local swelling 2(12.5%), emaciation 1(6.25%) and fractured horn 2(12.5%) were observed. Out of 384 cattle slaughtered, 176(45.8%) livers were totally condemned. The major causes of liver condemnation were due to fasciolosis (54.5%), calcification (15.3%), cirrhosis (13.6%), abscess (10.8%), hydatidosis (4.6%) and unknown cause (1.2%). There was statistically significant difference between different body condition categories ($X^2 = 38.833$; $p < 0.05$) of cattle. The current study revealed that fasciolosis was the major cause of liver condemnation followed by calcification, cirrhosis, abscess, hydatidosis and unknown causes. The annual financial loss was estimated to be 47,334 Ethiopian birr due to condemnation of liver. Therefore, in order to reduce this loss government and private agencies should have to work together on liver diseases that are commonly observed on abattoir survey.

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1. Introduction

Ethiopia has the largest livestock population in Africa with an estimated population of 56.7 million cattle, 29.8 million sheep, 29.13 million of Goats, 9.8 million equines, 1.12 million camels and 56.81 million poultry (CSA, 2014). The livestock subsector currently support and sustain livelihoods 80% of Ethiopian population. The GDP of livestock related activities valued at birr 59 billion (Metaferia *et al.*, 2011).

Ethiopia's great livestock potential is not properly exploited due to different factors such as traditional management system, limited genetic potential, lack of appropriate disease control policy and lack of appropriate veterinary services. Each year a significant loss results from death of animals, inferior weight gain, condemnation of edible organs and carcass at slaughter (Gryseals, 1988). 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 objectives lies primarily with the relevant public health authorities, who are represented

by veterinarian and meat inspectors at the abattoir stages (FAO, 2007). Meat and meat products are extremely perishable, therefore special care and handling must exercised during all operations (Marta, 2010).

The purpose of meat inspection is to protect public health and to provide risk free products to the society also; it provides information that can be utilized for animal diseases control (Teka, 1997). Abattoir-data is an excellent option for detecting diseases of both economic and public health importance, especially in ascertaining the extent to which human is exposed to certain zoonotic diseases in addition to estimating the financial implications of carcass condemnations (Asmare *et al.*, 2012).

Each year a significant economic loss results from mortality, poor body weight, condemnation of edible organs and carcass at slaughter. This production loss at the livestock industry is estimated more than 900 million USD annually (Jobre *et al.*, 1996). Meat inspection, in addition to its primary function of insuring safe and healthy meat to consumer, has a function of monitoring disease in the nation herd and flock by providing feedback information to the

veterinary service to control or eradicate disease and in developing countries it plays a major role in providing and serving as a source of information and reference center for disease prevalence (Nfi and Alonge, 1987).

Bovine liver is one of the largest visceral organs in the animal body which performs numerous functions and very rich sources of vitamins and minerals (Radostits *et al.*, 2007). The tissue is much sought by consumers due to its palatability and easy to consumption. However, it is one of the most commonly condemned visceral organs during routine meat inspection (Phiri, 2006).

Routine post mortem inspection of carcass or an organ should be carried out as soon as possible after completion of dressing. The final judgment as to taken with an organ, a carcass or parts of a carcass is based on the total evidence produced by antemortem examination, visualization, palpation, incision, and the results of any laboratory test (Teka, 1997). The main purpose of postmortem examination is to detect and eliminate abnormalities, including contamination, thus ensuring the only meat fit for human consumption is passed for food (Gracy, 1999).

The main causes of liver condemnation during postmortem inspection are disease originated by parasites, bacteria and viruses. Of these diseases, liver fluke and hydatid cyst are mainly involved (Urquhart *et al.*, 1996). Various surveys have been conducted to determine the prevalence and financial losses resulting from condemnation of liver in Ethiopia. Most of the surveys paid much attention to the parasite cause of liver condemnation, but not other causes. Fasciolosis and hydatidosis are usually considered to be of major economic and public health importance (Phiri, 2006).

Abattoir data are primary data sources and plays a major role in providing information for reference center for disease prevalence. Meat inspection is conducted in the abattoir for the purpose of screening animal products with abnormal pathological lesions that are unattractive and unsafe for human consumption. Meat inspection assists to detect certain diseases of livestock and prevent the distribution of infected meat that could give rise to disease in animal and human being and to insure competitiveness of products in the local market (Vanlontestijn, 1993). It is necessary to be aware of the extent to which the public is exposed to certain zoonotic diseases detected in abattoirs and financial loss through condemnation of organs (Nfi and Alonge, 1987).

Most of the abattoir studies undertaken on prevalence of fasciolosis and hydatidosis and the extent of loss from organs condemnation in different parts of Ethiopia. Most of the studies not included other major problems of condemnations in different parts of the country (Nurit *et al.*, 2012).

Currently there is lack of information on specific causes of liver condemnation and prevalence of disease or conditions that lead to liver condemnation and proper evaluations of financial losses due to liver condemnation resulting from various diseases at Debre Birehan municipality abattoir. Therefore, the objectives of this study were: Identify the major cause of liver condemnation and estimate the magnitude of direct financial losses due to cattle liver condemnation at Debre Birehan municipality abattoir.

2. Materials and Methods

2.1. Study Area

The study was conducted from November 2015 to April 2016 at Debre Birehan municipal abattoir, North Shoa administrative zone of Amhara National Regional State. Debre Birehan municipality abattoir slaughters cattle for local consumption. It is geographically located at lat. 9° N and long 39° E with an altitude of 2780 m a.s.l (CSA, 2008). The climatic condition is characterized by the presence of biannual rainfall (short and long) and dry season which is relatively cool temperature. The rainy season of this area extends from February to April and June to September while the dry season extends from November to January. The mean annual temperature of the area is 12.9°C with minimum and maximum temperature of 6.1°C and 19.9°C, respectively. Its average annual rain fall is 905.4mm and relative humidity is 62.3% (Dsmbc, 2006).

2.2. Study Animals

The study was conducted on cattle slaughtered at Debre Birehan municipal abattoir. The animal destined for slaughters were males and females originated from different parts of north Shoa zone such as, Ankober, Cha Cha, Tegulet, Kotu, Shoarobit, Mendida, Deneba, Menze, Giru and so on. They were transported to the abattoir on foot and by vehicle. A total of 384 cattle destined for slaughter inspected during antemortem and postmortem inspections with specific identification numbers and recorded accordingly on a format prepared for this purpose.

2.3 Study Design

A cross-sectional study was conducted from November 2015 to April 2016 on cattle slaughtered at Debre Birehan municipality abattoir. Every animal during the study period was examined and data was recorded. In this study, according to Pace and Wake Man. (2003), cattle were grouped in to young (<2 years), young adult (2-6years), adult (6-8years), and old (>8years) and age estimation based on eruption of one or more incisor teeth according to De- Lahunta and Habel (1986) were recorded According to Nicolson and butter worth (1986), body conditions of the animals were recorded as poor, medium and good. In this study, cattle were randomly sampled using

systematic sampling methods. They were selected for every third entry and examined by antemortem examination and postmortem examination for three days per week of visiting the abattoir (Friday, Saturday and Monday).

2.4. Sampling Technique and Sample Size Determination

A systematic sampling method was used for sampling and Sample size was determined by using the formula described by Thrusfield (2005).

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

n=required sample size

P_{exp}=expected prevalence

d=desired absolute precision(0.05)

Taking expected prevalence of 50%, since there was no reported prevalence and 95% confidence interval with desired absolute 5% precision, a total of 384 cattle were sampled in this study.

2.5. Study Methodology

Antemortem examination: Antemortem inspections were conducted on live animals while the animal/s entering in to the lairage. Both sides of the animals were inspected at rest and in motion state. Moreover, the general behavior of the animals, cleanliness, and sign of diseases and abnormality of any type were recorded according to the standard antemortem inspection procedures (Gracy, 1999). Following these, judgment was passed based on FAO (2007) guidelines. Animals fit for slaughter were allowed for slaughter.

Postmortem examination: During postmortem examination liver was thoroughly examined by visual, inspection, palpation and making systematic incision of liver to look for the presences of cysts, adult parasites and other abnormalities. Pathological lesions were differentiated and judged based on FAO (2007) guidelines on meat inspection for developing countries. The decisions at postmortem examination 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 according to FAO (2007) guideline on meat inspection for developing countries.

2.6. Economic Loss Assessment

The affected liver was rejected from local market. The annual economic loss as a result of liver condemnation was based on the average annual slaughter capacity of the abattoir considering market demand, average market price in local market and the

rejection rate of liver at Debre Birehan municipality abattoir. Average market price of liver was determined from interviews made with personnel's of the abattoir and butcher men. The economic loss due to condemnation of liver was estimated by using the formula indicated by Ogunrinade and Adesoke (1982) as follows:

$$EL = \sum S_{rx} \times C_{oy} \times R_{oz}$$

Where;

EL = average annual loss estimated due to liver condemnation from the local market.

$\sum S_{rx}$ = average annual cattle slaughter rate of abattoir.

C_{oy} = average cost of each cattle liver.

R_{oz} = condemnation rate of cattle liver.

2.7. Data Management and Analysis

All data collected from the slaughtered cattle were entered in to micro soft excel worksheet and were analyzed using Statistical Package for Social Science (SPSS) software version 20. Descriptive statistics such as, percentage was used to determine the level of liver condemnation rate. The associations between the various potential risk factors like age, origin, sex and body condition of animal assed by Pearson Chi-square (X^2) and p- value < 0.05 was considered as significant.

3. Results

3.1. Antemortem Findings

Among a total of 384 cattle inspected for antemortem, 16(4.17%) cattle were found to have abnormalities that need special care at postmortem inspection and/or suspend the cattle from being slaughtered. Various abnormalities were observed during the antemortem inspection. Among abnormalities encountered in antemortem inspection, rough hair coat was relatively the commonest antemortem finding that accounts for about 6(37.5%) followed by lameness 3(18.5%) (Table 1).

3.2. Postmortem Findings

From a total of 384 cattle slaughtered in Debre Birehan municipality abattoir during the study period, 176(45.8%) livers were found to be unfit for market and human consumption and subjected to organ condemnation. It was due to different pathological lesion arising from different causes. From which, fasciolosis was the major cause that share a quarter of condemned liver 96 (25%), followed by Hydatidosis 8(2.1%), Calcification 27(7%), abscess 19(4.9), Cirrhosis 24(6.3%) and Unknown case 2(0.5%) (Table 2).

Table 1: Summary of abnormal conditions encountered during antemortem examination in the study area, 2015/16, n=384 at Debre Birhan municipality abattoir.

Condition encountered	Number of animal affected	Percentage
Lameness	3	18.75
Skin scar	2	12.5
Rough hair coat	6	37.5
Local swelling	2	12.5
Emaciation	1	6.25
Fractured horn	2	12.5
Total	16	100

Table 2: Major cause of liver condemnation, frequency and its proportion in the study area, 2015/16, n=384 at Debre Birhan municipality abattoir.

Major cause of liver condemnation	No. of liver condemnation	Proportion
Fasciolosis	96(25%)	54.5%
Calcification	27(7%)	15.3%
Cirrhosis	24(6.3%)	13.6%
Abscess	19(4.9%)	10.8%
Hydatidosis	8(2.1%)	4.6%
Un known	2(0.5%)	1.2%
Total	176(45.8%)	100%

From a total of 384 sampled animals 39 were females and 345 were males. Among 176 positive animals 22 were females and the remaining 154 were males, the rate of liver condemnation was 56.4% and

44.6% in females and males, respectively. There was no statically significance difference observed between the two sex categories $\chi^2=4.792$; $P=0.57$ (Table 3).

Table 3: Liver condemnation rate based on sex, 2015/16, n=384 at Debre Birhan municipality abattoir.

Sex	No. of animal examined	No. of positive animals	Rejection rate	χ^2	P-value
Female	39	22	56.4	4.792	0.57
male	345	154	44.6		
Total	384	176	45.8		

The rate of liver condemnation was higher from adult cattle compared to the liver rejected from old cattle. But there was no statically significant

association between the two age categories ($\chi^2=1.078$; $P=0.98$) (Table 4).

Table 4: Liver condemnation rate based on Age of cattle in the study area, 2015/16, n=384 at Debre Birhan municipality abattoir.

Age of animal examined	No. of animal examined	No. of positive animals	Rejection rate	χ^2	P-value
Adult	302	138	46.7	1.078	0.98
Old	82	38	46.3		
Total	384	176	45.8		

Regarding the agro ecology, among the total of sampled cattle, 282 were from high land and the remaining 102 from low land areas. From those animal coming from the different origin 134 (47.5%) and 42

(41.2%) were positive in high land and lowland, respectively. However, no statically significance difference was observed between the two agro-ecologies ($\chi^2=8.469$; $P=0.21$) (Table5).

Table 5: Liver condemnation rate based on origin of animals, 2015/16, n=384 at Debre Birhan municipality abattoir.

Origin of the animals	No. of animal examined	No. of positive animals	Rejection rate	χ^2	P-value
High land	282	134	47.5	8.469	0.21
Low land	102	42	41.2		
Total	384	176	45.8		

The higher rate of liver condemnation was observed in poor body conditioned animals (Table 6). From a total of 39 poor body conditioned cattle slaughtered, 59% of livers were condemned. The lower rate of liver condemnation was observed in

good body conditioned animals. From a total of 97 good body conditioned cattle slaughtered 24.7% of liver condemned. There was statically significance association observed between the different body condition categories ($\chi^2=38.833$; $P=0.000$) (Table 6).

Table 6: Liver condemnation rate based on body condition of animals, 2015/16, n=384 at Debre Birhan municipality abattoir.

Body condition	No. of animal examined	No. of positive animals	rejection rate	χ^2	P-value
Good	97	24	24.7	38.83	.000
Medium	248	129	52.0		
Poor	39	23	59.0		
Total	384	176	45.8		

3.3. Assessment of Financial Loss

Average annual slaughter capacity at Debre Birehan municipality abattoir was 4900 cattle. Using the formula set by Ogunrinade (1982), the average

annual direct economic loss due to liver condemnation in local market at Debre Birehan municipality abattoir was estimated to be 47,334 Ethiopian birr.

Table 7: Finding of Economic loss assessment, 2015/16, n=384 at Debre Birhan municipality abattoir.

Organ	Rejection rate of liver	Number of liver condemned	Average current price of liver
Liver	45.8%	4900	21ETB

4. Discussions

In the present study, routine antemortem inspection was carried out to detect any abnormalities encountered in Debre Birehan municipality abattoir. The most commonly encountered abnormalities during antemortem inspection were rough hair coat 6(37.5%), lameness 3(18.75%), local swelling 2(12.5%), skin scar 2(12.5%), fractured horn 2(12.5%) and emaciation 1(6.25%). Similar antemortem finding were reported by other studies: (Marta, 2010) at Sebeta municipality abattoir, Asmare *et al.* (2012) at Bahir dar municipality abattoir and wondemagegnehu (2012) at Wolaita Sodo municipality abattoir. These antemortem findings similarity may be due to same husbandry and management practice in livestock throughout the country. It could be due to stress, physical trauma during driving of the animal on foot to the abattoir and overcrowding in lairage.

In the current study, out of the total 384 cattle slaughtered, 176(45.8%) liver were condemned due to various causes. This finding is comparable with Shegaw(2008) that report 43.7% at Mekele. However, it is higher to the studied carried out by Yifat *et al.* (2011) and Mellau *et al.* (2010) who reported 31.1% and 17.61% in Gondar and Arusha abattoir, Tanzania respectively. But this result is much lower reported by Nurit *et al.* (2012) that revealed 66% at Kombolcha industrial abattoir. The variation of this study could be due to difference in the epidemiology of disease prevalence and disease condition causing liver condemnation in the area.

In the present study, among the different cause responsible for liver condemnation, Fasciola take the

lion share (54.5%) followed by calcification (15.3%), cirrhosis (13.6%), abscess (10.8%), Hydatidosis (4.6%) and unknown cause (1.2%). This result was in agreement with the previous studies conducted by Asmare *et al.* (2012), Fitsum (2009) and Marta(2010) at Bahir Dar, Hawassa and Sebeta abattoirs, respectively who reported fasciolosis was the major cause of liver rejection.

The current finding (54.5% bovine fasciolosis) seems to be relatively lower than the finding by Tilahun(1994) and Sirak(1991) which report a rejection rate of 71% and 58% of liver due to fasciola at Addis Ababa and Bahirdar abattoir, respectively. But this result is much higher than the report of Fufa *et al.* (2009) in Wolaita Sodo and Mellau *et al.* (2010) in Arusha, Tanzania, which is reported 12.7 and 8.6% liver condemnation due to fasciolosis, respectively. The reduction in bovine fasciolosis as compared to the report of Tilahun (1994) and Sirak (1991) could be due relatively good practice of regular deworming and also strategic drainage of marshy area to reduce the survival of intermediate host.

In the present study, the rejection rate of liver due to hydatidosis is 4.6% which is much lower than the finding of Nurit *et al.* (2012) at kombolcha and Asmare *et al.* (2012) at Bahir Dar abattoir which reports 14.32 and 12.0%, respectively. This result is comparable with the result of Yifat *et al.* (2011) at Gondar and Mellau *et al.* (2010) at Tanzania, which reports 3.7 and 3.2%, respectively. The relative lower result as compared to other studies might be due to proper removal of infected carcass and good system of animal husbandry.

A 15.3 % liver condemnation due to calcification was recorded in the present study. This result is in agreement with the report by Nurit *et al.* (2012) and is relatively higher than the finding of Mellau *et al.* (2010) at Arusha abattoir, Tanzania, which is 1.9%. In the present study, a 4.9% liver condemnation due to abscess was recorded. This is similar to the report by Nurit *et al.* (2012), who report 4.09 condemnation of liver due to hepatic abscess at Kombolcha, but it is higher than the report of Mellau *et al.* (2010) which is 1.1% at Tanzania.

Cirrhosis was also among the lesion which significantly contributes to liver condemnation in the study abattoir. During this study, 6.3% of liver was condemned as a result of cirrhosis which is relatively higher than the finding of Yifat *et al.* (2011) and less than the finding of Nurit *et al.* (2012), which is 10.9%. A 0.5% liver condemnation was incurred by unknown causes, which doesn't show pathognomonic pathological lesions.

In current study, condemnations of liver were recorded in sex (males and females), origin (high land and low land), age (adult and old) and body condition of animals (good, medium and poor). Among those risk factors presented in the study; only body condition of the animals show statistically significant association ($P < 0.05$) to liver condemnation. This might be that the body status of the animal could be affected by multifactor like nutrition, management, disease condition and others that expose the liver to pathological lesion and lastly subjected to liver condemnation.

The average annual financial loss as a result of liver condemnation was estimated to be 47,334 ETB which equivalent to 2,151 USD (1 USD = 22 ETB) per annum based on the current exchange. This figure is higher than the report of economic loss in abattoir by Nurit *et al.* (2012) and Mwabonimana *et al.* (2009) who reported 12,810 ETB and 39,600 ETB (18,000 USD) at Kombolcha and Arush abattoir, Tanzania, respectively. However, the current result found was lower than the economic loss reported by Asmare *et al.* (2012) who reported 170,676 ETB from the condemnation of liver at Bahir Dar municipality abattoir. This variation might be due to different rate of liver condemnation and capacity of abattoir.

Conclusions and Recommendations

Liver disease is the major causes of organ condemnation and the major concern to the livestock industry as it causes financial loss as a result of direct and indirect economic loss. According to the result of the current study; fasciolosis (54.5%), hydatidosis (4.6%), calcification (15.3%), abscess (10.8%), cirrhosis (13.6%) and un known causes (1.2%) were among the major cause for liver condemnation.

Among those diseases fasciolosis and calcification were the major one. Hydatidosis which was one of the causes of liver condemnation has implication of public health hazard in addition to its economic effect. Estimated annual direct economic loss of 47,334 ETB was incurred in this abattoir. In line with conclusion the following recommendations are forwarded:

➤ In order to control major disease problem of liver in animals, government and private agencies should have to work together on disease that is commonly observed on the abattoir survey.

➤ Strategic deworming of animals in areas where specific disease prevalence is high coupled with good animal husbandry should be practiced.

➤ Further studies should be carried out on cattle to be slaughtered in different abattoirs in the country to obtain full and documented information.

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