INTRODUCTION

The camel (Camelus dromedaries) is an important livestock species uniquely adapted to hot arid environments. It is most numerous in the arid areas of Africa, particularly in the arid lowlands of Eastern Africa namely, Somalia, Sudan, Ethiopia, Kenya and Djibouti. Approximately, 11.5 million animals in this region represent over 80% of the African and two thirds of the world's camel population (Schwartz, 1992).

Ethiopia is one of the largest camel populated countries in the world; in Africa, it ranks third next to Somalia and Sudan (FAO-OIE-WHO, 1993). Diseases in camels cause considerable economic losses due to condemnation of edible organs and decreased meat/milk production (Romazanovic, 2001). Meat of camel
is one of the components of diet for the pastoralist and residences of Somali ethnic groups in Addis Ababa, capital of Ethiopia (Muskin et al., 2011).

In developing countries, abattoir plays a major role in providing and serving as sources of information and reference centre 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 (Nurit et al., 2012). 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 (Hinton and Green, 1993). 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 of certain livestock diseases (Alemayehu et al., 2013).

Monitoring and other conditions at slaughterhouse have been recognized as one way of assessing the disease status of camel and abattoirs played an important role in screening animal products with various abnormalities and diseases that are not fit for human consumption (Alembhan and Haylegebriel, 2013). The results of meat inspection at slaughterhouses with appropriate trends indicate possible risks due to unsafe meat obtained from camel carcasses at the slaughterhouses. Such risks are eliminated by strict veterinary inspection of animals prior to slaughter as well as of meat and parenchymatous organs after slaughter. Slaughterhouses provide an excellent opportunity for detecting pathological lesions of both economic and public health importance (Ahmed et al., 2013).

In Ethiopia, there is gap of information on causes of carcass condemnation and the status of camel diseases that put the public at risk of acquiring zoonotic food borne diseases. In this regards, as Ethiopian dromedaries are primarily reared by pastoralists, abnormalities of carcass and edible organs could have significant economic and public health consequences in the regions. However, abattoir based epidemiological studies are needed to show the real picture of abnormalities and lesions resulting in carcass and organ condemnation in camels so that this would suggest impact on economy and public health. Therefore, the objective of the present study was to identify the different causes of organ condemnation in camel slaughtered at Addis Ababa Akaki Abattoir and to gather information on the spectrum of diseases.

**MATERIALS AND METHODS**

**Study Area**

The study was conducted from January to April 2014 at Akaki abattoir, which is located in Addis Ababa, the capital city of Ethiopia, with a mean annual minimum and maximum temperature of about 21 to 27°C, respectively (NMSAE, 2012). Although the camel meat is not popular in Addis Ababa, the only Somali community and some other Muslim communities who live in the city are the main consumers of camel meat from this abattoir. As a result the Akaki abattoir usually slaughters an average of seven camels per day. In addition, this abattoir also gives service to the hotels and restaurants of the Akaki town by slaughtering cattle, sheep and goats every day.

**Study Population and Sampling Method**

The study animals were local camels (*Camelus dromedaries*) slaughtered at the Addis Ababa Akaki abattoir. The camels slaughtered at the abattoir were both male and female that originated from pastoral areas of the country mainly from Borena and Bale zones, Fentale district of East Shoa zone and Meiso district of West Hararghe zone, Ethiopia.

**Table 1: Abnormalities encountered during ante-mortem examination**

<table>
<thead>
<tr>
<th>Abnormality</th>
<th>No. of animals with disease condition</th>
<th>Proportion (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lameness</td>
<td>5</td>
<td>11.11%</td>
</tr>
<tr>
<td>Localized swelling</td>
<td>9</td>
<td>20.20%</td>
</tr>
<tr>
<td>Dirty wool</td>
<td>3</td>
<td>6.66%</td>
</tr>
<tr>
<td>Blindness</td>
<td>2</td>
<td>4.44%</td>
</tr>
<tr>
<td>Emaciation</td>
<td>14</td>
<td>31.11%</td>
</tr>
<tr>
<td>Rough hair coat</td>
<td>12</td>
<td>26.66%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>45</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

The purposive sampling method was used for sampling. All camels presented for slaughter during the investigation period were sampled for this epidemiological study. Accordingly, during the period of investigation averagely seven camels were slaughtered each day and a total of 385 camels were examined.
Table 2: Distribution of number and sex of camel slaughtered and organ rejection rates

<table>
<thead>
<tr>
<th>Sex</th>
<th>Total number (%) of organ condemned</th>
<th>Lung</th>
<th>Liver</th>
<th>Heart</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Camel Slaughtered</td>
<td>52 (61.90%)</td>
<td>9 (10.71%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Male</td>
<td>84 (21.81%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>301 (78.18%)</td>
<td>178 (59.13%)</td>
<td>25 (14.04%)</td>
<td>6 (1.99%)</td>
</tr>
<tr>
<td>Total</td>
<td>385</td>
<td>230 (59.74%)</td>
<td>34 (8.83%)</td>
<td>6 (1.55%)</td>
</tr>
</tbody>
</table>

STUDY METHODOLOGY
Thorough meat inspection procedure involving both ante-mortem and post-mortem inspection was performed.

ANTE-MORTEM EXAMINATION
Ante-mortem examination was conducted on individual animals, while the animals were entering into the lairage and in mass after they entered into the lairage. Both sides of the animals were inspected at rest and in motion. Moreover, the general behaviour of the animals, cleanliness, and sign of diseases and abnormality of any type were recorded according to the standard ante-mortem inspection procedures (FAO, 1994).

POST-MORTEM EXAMINATION
Post mortem examination was carried out by visual inspection, palpation and systematic incision on visceral organs, i.e., lung, liver, heart, kidney and spleen; according to procedures recommended by Food and Agricultural Organization (FAO, 1994).

DATA ANALYSIS
Data collected during the study were entered into Excel spread sheet (Microsoft Excel 2007) and analyzed by statistical methods using SPSS version 16. Descriptive statistics such as percentage was used to determine the level of organs condemnation rate. The association of prevalence of lesions on different organs with sex and body condition of the animals was assessed by Pearson chi-square ($X^2$) and the $p$-value $< 0.05$ was considered significant.

RESULTS

ANTE-MORTEM EXAMINATION
Out of the 385 camels examined at ante-mortem, 45 (11.69%) camels were found to have the abnormalities (Table 1). The most common abnormalities encountered during ante-mortem inspection were lameness (11.11%), localized swelling (20.20%), blindness (4.44%), emaciation (31.11%), dirty wool (6.66%) and rough hair coat (26.66%).

RATE OF ORGAN CONDEMNATION
The post-mortem examination was performed for all the slaughtered camels (n=385). From the total organs examined 230 (59.74%) lung, 34 (8.83%) liver and 6 (1.55%) hearts were condemned or rejected as unfit for human consumption based on gross pathological findings (Table 2).

Table 3: Causes of Lung condemnation and their percentage (%)

<table>
<thead>
<tr>
<th>Causes</th>
<th>Number condemned</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydatid cyst</td>
<td>64</td>
<td>16.62%</td>
</tr>
<tr>
<td>Calcified cyst</td>
<td>29</td>
<td>7.53%</td>
</tr>
<tr>
<td>Emphysema</td>
<td>64</td>
<td>16.62%</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>43</td>
<td>11.17%</td>
</tr>
<tr>
<td>Calcification</td>
<td>25</td>
<td>6.49%</td>
</tr>
<tr>
<td>Abscess</td>
<td>3</td>
<td>0.78%</td>
</tr>
<tr>
<td>Discoloration</td>
<td>2</td>
<td>0.52%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>230</strong></td>
<td><strong>59.74%</strong></td>
</tr>
</tbody>
</table>

Table 4: Causes of Liver and heart condemnation and their percentage (%)

<table>
<thead>
<tr>
<th>Organ</th>
<th>Causes</th>
<th>Number condemned</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liver</td>
<td>Hydatid cyst</td>
<td>15</td>
<td>3.90%</td>
</tr>
<tr>
<td></td>
<td>Calcified cyst</td>
<td>2</td>
<td>0.52%</td>
</tr>
<tr>
<td></td>
<td>Calcification</td>
<td>6</td>
<td>1.56%</td>
</tr>
<tr>
<td></td>
<td>Abscess</td>
<td>2</td>
<td>0.52%</td>
</tr>
<tr>
<td></td>
<td>Hepatitis</td>
<td>5</td>
<td>1.30%</td>
</tr>
<tr>
<td></td>
<td>Discoloration</td>
<td>4</td>
<td>1.04%</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>34</strong></td>
<td><strong>8.83%</strong></td>
</tr>
</tbody>
</table>

| Heart | Calcified cyst | 4                | 1.04%       |
|       | Pericarditis   | 2                | 0.52%       |
|       | **Total**      | **6**            | **1.55%**   |
Table 5: Prevalence of hydatid cyst on lung of camels slaughtered at Addis Ababa Akaki Abattoir in relation to sex and body condition score

<table>
<thead>
<tr>
<th>Variable</th>
<th>Observation</th>
<th>Number of positive</th>
<th>Chi-square value</th>
<th>P-value</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>Male</td>
<td>16(19.05%)</td>
<td>0.456</td>
<td>0.500</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>48(15.95%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body condition score</td>
<td>Good</td>
<td>32(10.46%)</td>
<td>44.758</td>
<td>0.000*</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>26(45.64%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Poor</td>
<td>6(16.62%)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*= p<0.005

Table 6: Prevalence of hydatid cyst on liver of camels slaughtered at Addis Ababa Akaki Abattoir in relation to sex and body condition score

<table>
<thead>
<tr>
<th>Variable</th>
<th>Observation</th>
<th>Number of positive</th>
<th>Chi-square value</th>
<th>P-value</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>Male</td>
<td>3(3.57%)</td>
<td>0.030</td>
<td>0.862</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>12(3.99%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body condition score</td>
<td>Good</td>
<td>9(2.94%)</td>
<td>4.389</td>
<td>0.111</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>5(8.77%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Poor</td>
<td>1(4.55%)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 7: Prevalence of emphysema on lung of camels slaughtered at Addis Ababa Akaki Abattoir in relation to sex and body condition score

<table>
<thead>
<tr>
<th>Variable</th>
<th>Observation</th>
<th>Number of positive</th>
<th>Chi-square value</th>
<th>P-value</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>Male</td>
<td>18(21.43%)</td>
<td>1.789</td>
<td>0.181</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>46(15.28%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body condition score</td>
<td>Good</td>
<td>52(16.99%)</td>
<td>0.344</td>
<td>0.842</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>8(14.04%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Poor</td>
<td>4(18.18%)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 8: Prevalence of pneumonia on lung of camels slaughtered at Addis Ababa Akaki Abattoir in relation to sex and body condition score

<table>
<thead>
<tr>
<th>Variable</th>
<th>Observation</th>
<th>Number of positive</th>
<th>Chi-square value</th>
<th>P-value</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>Male</td>
<td>9(10.71%)</td>
<td>0.022</td>
<td>0.881</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>34(11.30%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body condition score</td>
<td>Good</td>
<td>28(9.15%)</td>
<td>6.554</td>
<td>0.038*</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>10(17.54%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Poor</td>
<td>5(22.73%)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*= p<0.005

**Causes of Lung Rejection**
A total of 230 (59.74%) camel lungs were rejected for gross abnormalities (Table 3). Hydatid cyst (16.62%), emphysema (16.62%) and pneumonia (11.17%) were the major causes resulting in lung rejection.

**Causes of Liver and Heart Rejection**
From the total number of camel slaughtered 34 (8.83%) liver were rejected due to different pathological lesions. Hydatid cyst was the major cause resulting in liver rejection. A total of 6 (1.55%) camel heart were rejected for gross abnormalities (Table 4).

**Prevalence of Pathological Lesions on Different Organs**
The result also showed that distribution of lesions...
such as hydatid cyst (lung and liver), emphysema (lung) and pneumonia (lung) were differentially distributed in relation to body condition and sex of animals. Higher rate of hydatid cyst in lung was detected in male (19.05%) than female (15.95%); and camels with good (78.18%) body condition score were found to bear considerably higher ($p<0.05$) cysts in their lung as against those having poor (14.81%) and medium (5.71%) body condition score (Table 5). Whereas for the liver, both male (3.57%) and female (3.99%) were infested more or less with a similar rate, and medium body condition camels (8.77%) had higher rate of hydatid cyst infestation in their liver than poor (4.55%) and good body condition camels (0.94%) (Table 6).

There was no significant difference in the prevalence of both emphysema and pneumonia on the lung between sexes (Tables 7 and 8). However, lung of camels having poor body condition score was found to be highly affected ($p<0.05$) by pneumonia as compared to those with medium and good body condition score (Table 8).

**DISCUSSION**

**Meat Inspection**

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

The most commonly encountered abnormalities during ante-mortem inspection, in the present study, were lameness, localized swelling, blindness, emaciation, dirty wool and rough hair coat, 11.11%, 20.20%, 4.445, 31.11%, 6.66% and 26.66% respectively. The present study revealed that the most commonly encountered abnormalities during post-mortem inspection were hydatid cyst and emphysema.

**Major Causes of Organ Condemnation**

Among the disease conditions encountered during the post mortem examination, hydatid cyst, emphysema and pneumonia were the major causes of lung condemnation, while hydatid cyst was the major cause of liver condemnation. However, the disease condition or abnormalities detected in the heart have approximately less contribution for the condemnation of the organs. From the total number of camels slaughtered, 64 (16.62%), 64 (16.62%) and 43 (11.17%) lungs were condemned due to hydatid cyst, emphysema and pneumonia respectively. Hydatid cyst condemned 15 (3.90%) camel liver during the study period.

The overall prevalence of hydatidosis at Addis Ababa Akaki abattoir was 16.62% and it has been observed that it occurred predominantly in the lung. This finding is closer to that reported by Regassa et al. (2009) from Wolaita Sodo abattoir (15.4%). However, this finding lower than that of Yifat et al. (2011), Jobre et al. (1996) and Kebede et al. (2009) from Gondar (24.2%), South Omo (25.7%) and Tigray (22.1%) regions respectively. This report is higher than the report of Alembrhan and Haylegebriel (2013) who reported 5.1% from Adigrat.

Factors like differences in culture, social activity, systems of animal husbandry, lack of proper removal of infected carcass and approach to dogs in various regions might have accounted for variation of the prevalence in different areas of a country (Yifat et al., 2011). The lung is the most frequently having hydatidosis due to its size, blood supply and availability of oxygen supply (Amene et al., 2012).

**Rate of Organ Condemnation**

The prevalence of emphysema and pneumonia were 16.625 and 11.17% respectively. This finding is higher than the rejection rate of 1.5% for emphysema and 1.8% for pneumonia as reported by Yifat et al. (2011) and Marta (2010) at Gondar and Sebeta abattoirs, respectively. Emphysema and pneumonia could be due to exposure of animal to bacterial or viral origin infections, stress factors including exposure to dust and starvation. Moreover, penetration of lung by foreign body, adverse weather condition or accidental inhalation of liquid may cause pneumonia (Amene et al., 2012). The prevalence of emphysema in the present study was lower than reported by Kambarage et al. (2000) with 22% in Tanzania and Seboka (2008) with 43.75% in Addis Ababa Municipal Abattoir. But, this finding is closer to the figure (16.53%) reported by Abayneh (1999) in Assela Municipal Abattoir.

Pneumonia which was another pathological condition attributed to 11.17% of rejection rate. A lower rejection rate of 31.02% was reported by Cadamus and Adesokan (2010) from Nigeria. Whereas, a high-
The rate of liver condemnation in this study was 8.83% which is lower than the report of Denberga et al. (2011) in Gondar ELFORA abattoir (31.1%), Yifat et al. (2011) in Gondar ELFORA abattoir (31.1%) and Alembrhan and Haylegebriel (2013) in Adigrat abattoir (17.58%). Liver condemnation due to hydatid cyst (3.90%) in the present study was lower than studies conducted by Gebretsadik (2009) who reported 12.56% from Tigray, by Miheret et al. (2013) 33.33% from Dire Dawa, by Zelalem et al. (2012) 31.7% from Addis Ababa and Asmare et al. (2012) 10.2% from Bahir Dar municipal abattoirs. Prevalence of hydatid cyst on liver was higher than studies conducted by Yifat et al. (2011) in Gondar ELFORA abattoir which was 1.2% and although the present study was closer to the figure reported by Alembrhan and Haylegebriel (2013) in Adigrat abattoir (3.62%).

The rate of heart condemnation in this study was 1.55% which is closer to Yifat et al. (2011) in Gondar ELFORA abattoir (1.0%) and higher than studies conducted by Amene et al. (2012) in Jimma abattoir (0.44%). However, a lower rejection rate of Pericarditis (36.0%) was reported by Kambarage et al. (2000) from cattle slaughtered in Tanzania.

CONCLUSIONS

A considerable number of organs were condemned from camels slaughtered at Akaki Abattoir, Addis Ababa mainly due to different pathological lesions on different organs such as hydatid cyst, emphysema and pneumonia during the present study. Affected meat were condemned and rendered unfit for human consumption. Some of the limitations, however, encountered in this study including the use of only gross pathology in the diagnosis of the diseases, thus only those diseases with gross pathological lesions that are pathognomonic were likely to be diagnosed. Taken as a whole, the public health implication of the quality of infected organs condemned at this abattoir on the customers and the role which post-mortem inspection plays in safeguarding the health of the public cannot be overemphasized. In conclusion, therefore, there is a need for adequate meat inspection in the abattoirs in order to identify diseases and thereby minimize associated public health risks.

ACKNOWLEDGEMENTS

The authors would like to acknowledge Addis Ababa Akaki Abattoir center office for their critical support during data and sample collection.

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