

# Study on gross pulmonary lesions in lungs of slaughtered animals and their economic importance in Tigray, Ethiopia

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## **ABSTRACT**

A cross-sectional epidemiological study on slaughtered cattle at Mekelle abattoir, Northern Ethiopia, was conducted from November 19, 2008 to February 21, 2009 to investigate the distribution and risk factors of pulmonary lesions. The pulmonary lesions and diseases were diagnosed on the basis of pathological findings. Out of the 1,148 slaughtered cattle examined, 990 (86.2%) had one or more lesions. The prevalence of pulmonary lesions in the slaughtered cattle varied among categories of the study variables. The most common lesions were congestion (38.5%), emphysema (36.3%), hydatidosis (18.3%), abscesses (7.1%) and verminous pneumonia (3.2%). The risk factors identified on statistical basis ( $p < 0.05$ ) were fat in cattle in pulmonary congestion, old age ( $>7$  years) and very lean cattle in pulmonary emphysema and pulmonary abscesses and young age ( $<7$  years) in verminous pneumonia. A total of 990 lungs (86.2%) were condemned or partially trimmed due to pulmonary lesions with an economic loss of 7,920 Ethiopian Birrs (ET Birr). This loss was calculated from the mean retail local market price of cattle lung and the total number of lungs condemned during the study period. Annual economic loss due to lung condemnation, determined by considering annual slaughter rate of cattle and prevalence of lung lesions in the abattoir, was estimated to be 65,000 ET Birr (US\$).

**Keywords:** Pulmonary lesions, Cattle, Abattoir, Economic loss, Ethiopia.

## **1. INTRODUCTION**

Although the proportional contribution of livestock and crops will fluctuate from year to year, if we include the value of ploughing services, livestock contributed 45% of agricultural Gross Domestic Product (GDP) in 2008/09 in Ethiopia (IGAD, 2012). Animal diseases are one of the primary constraints in increasing the productivity of food animals in sub-Saharan Africa (Lemma et al., 2001). Among list 15 A and list 12 B diseases identified by the world animal health organization (OIE), 7 and 10, respectively, are confirmed in Ethiopia (DACA, 2006). Pulmonary diseases like tuberculosis, hydatid cyst, and lung worms are among the most important causes of economic loss due to carcass condemnation and public health problems (Vegad and Katiyar, 1998; Berhe et al., 2009). The prevalence of pulmonary lesions in Mekelle has not been previously studied. In view of the importance of the problem, a study was undertaken with the following objectives: (i) to assess the major pulmonary lesions leading to organ condemnation,

- (ii) to determine the association between risk factors and prevalence of pulmonary lesions, and
- (iii) to assess the economic losses due to lung condemnation during the study period.

## 2. MATERIALS AND METHODS

### 2.1. Study area

The study was conducted in Mekelle abattoir. Mekelle is the capital city of the Tigray national regional state in northern Ethiopia. It is located at 39°29'E and 13°30'N. Mekelle has altitude above 2,000 m above sea level. Mekelle abattoir is the oldest and the largest abattoir in Tigray. It was established in 1964 and, on an average, 8,206 cattle are slaughtered annually for domestic market. Slaughtered animals originate predominantly from different areas of Tigray and the neighboring Afar regional state.

### 2.2. Sampling methodology

To determine the sample size 50% prevalence is used and 95% confidence interval with 5% absolute precision is chosen. The sample size was determined by the formula given by Thursfield (1995).

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

Where, N = required sample size;  $P_{\text{exp}}$  = expected value;  $d^2$  = desired absolute preclusion.

By substituting these values in the formula, 384 cattle were required. But 1,148 cattle were selected using random sampling method to increase the precision of the estimated prevalence of the lesions.

### 2.3 Data collection

The data was collected through postmortem inspection of animals. Examination of lungs was carried out for any lesions, like abscesses, hydatid cyst, lung worm, emphysema and congestion. During the ante-mortem inspection, age, sex, breed and body condition of each animal was assessed and recorded. Animals based on their body condition score were ranked as very lean, lean, medium, and fat. Animals were identified based on enumeration marks (mostly numbers) on the gluteal surface using ink and the marks were transferred to all visceral organs after ante mortem slaughtering. A total of 1,148 cattle were examined in the abattoir from November 2008

to February 2009. During postmortem examination a thorough visual inspection, palpation and systematic incision of lungs was carried out according to procedures recommended by FAO (1994). All abnormalities in lung, like hydatid cyst, congestion, emphysema, abscess and lung worms, and anatomical locations of the abnormalities were recorded. The retail market price of an average size lung was obtained by information gathered from local butchers.

## 2.4 Data analysis

Data were recorded in Microsoft excel and analysis was done by comparing proportions using Pearson's chi-square test. The Prevalence of pulmonary lesions and diseases was calculated by dividing the number of lungs having lesion by the total number of animals examined. The economic lose due to lung condemnation is calculated from the lungs condemned and cost of lung during the study period in the study area.

## 3. RESULTS

### 3.1. Prevalence of pulmonary lesions

Out of the total 1,148 slaughtered cattle examined during the study, 990 (86.2%) were found to have pulmonary lesions. The prevalence of pulmonary congestion, emphysema, verminous pneumonia, pulmonary hydatidosis and pulmonary abscesses with respect to the age and body conditions of the slaughtered cattle are presented as follows.

#### 3.1.1. Pulmonary congestion

Prevalence of pulmonary congestion was significantly ( $p < 0.05$ ) associated with body condition of animals (Table 1), meaning it was more likely to be present in animals with good body condition. The results indicate that age had no significance effect on the distribution of pulmonary congestion.

Table 1. Prevalence of lesions of bovine pulmonary congestion.

|                | Variables | No. of cattle Examined | No. of positive Cases | %     | $X^2$ value | $p$ -value |
|----------------|-----------|------------------------|-----------------------|-------|-------------|------------|
| Age            | < 7 years | 431                    | 181                   | 41.99 | 3.557       | 0.59       |
|                | > 7 years | 717                    | 261                   | 36.4  |             |            |
| Body Condition | Fat       | 99                     | 51                    | 51.51 | 11.24       | 0.010      |
|                | Medium    | 243                    | 99                    | 40.74 |             |            |
|                | Lean      | 385                    | 130                   | 33.76 |             |            |
|                | Very Lean | 421                    | 162                   | 8.47  |             |            |

### 3.1.1. Pulmonary congestion

Prevalence of pulmonary congestion was significantly ( $p < 0.05$ ) associated with body condition of animals (Table 1), meaning it was more likely to be present in animals with good body condition. The results indicate that age had no significance effect on the distribution of pulmonary congestion.

### 3.1.2. Pulmonary emphysema

Prevalence of pulmonary emphysema among the cattle examined was 36.3% (Table 2). It was significantly ( $p < 0.05$ ) dependent on the age and body condition of the cattle, mostly occurring among older and lean cattle (Table 2).

Table 2. Prevalence of lesions of pulmonary emphysema.

|                | Variables | No. of cattle Examined | No. of positive Cases | %     | X <sup>2</sup> -value | p-value |
|----------------|-----------|------------------------|-----------------------|-------|-----------------------|---------|
| Age            | < 7 years | 431                    | 131                   | 30.39 | 10.49                 | 0.001   |
|                | > 7 years | 717                    | 286                   | 39.88 |                       |         |
| Body Condition | Fat       | 99                     | 16                    | 16.16 | 33.8                  | 0.000   |
|                | Medium    | 243                    | 88                    | 36.21 |                       |         |
|                | Lean      | 385                    | 124                   | 32.12 |                       |         |
|                | Very Lean | 421                    | 162                   | 8.47  |                       |         |

### 3.1.3. Pulmonary abscesses

Prevalence of pulmonary abscesses among the cattle examined is shown in table 3. Prevalence of pulmonary abscesses was significantly ( $p < 0.05$ ) higher among cattle with better body condition. However, it was not affected by the age of the cattle ( $p > 0.05$ ) (Table 3). Distribution of pulmonary abscesses and diseases varied significantly ( $p < 0.05$ ) among different lobes, the highest seen in the right caudal lobe (Fig 2a).

Table 3. Prevalence of lesions of pulmonary abscesses.

|                | Variables | No. of cattle Examined | No. of positive Cases | %    | X <sup>2</sup> -value | p-value |
|----------------|-----------|------------------------|-----------------------|------|-----------------------|---------|
| Age            | <7years   | 431                    | 33                    | 7.66 | 0.3                   | 0.538   |
|                | >7years   | 717                    | 81                    | 11.3 |                       |         |
| Body Condition | Fat       | 99                     | 0                     | 0    | 0.154                 | 0.017   |
|                | Medium    | 243                    | 14                    | 5.76 |                       |         |
|                | Lean      | 38                     | 31                    | 8.05 |                       |         |
|                | Very Lean | 421                    | 36                    | 8.5  |                       |         |

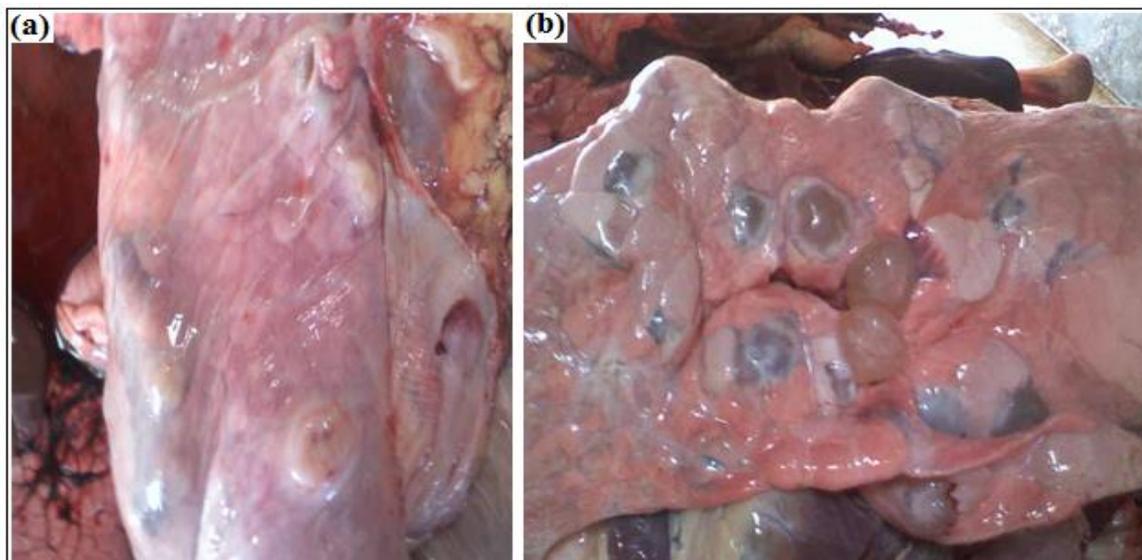


Figure 1. Example of (a) pulmonary abscesses and (b) different size hydatid cysts encountered on the lung of an ox slaughtered in Mekelle abattoir.

### 3.1.4. Pulmonary hydatidosis

Prevalence of pulmonary hydatidosis among the cattle examined was 18.3% (Table 4). The prevalence of pulmonary hydatidosis did not vary significantly ( $p > 0.05$ ) with the age and body condition of the cattle.

Table 4. Prevalence of cysts of pulmonary hydatidosis.

|                | Variables | No of cattle Examined | No. of positive Cases | %     | $\chi^2$ -value | $p$ -value |
|----------------|-----------|-----------------------|-----------------------|-------|-----------------|------------|
| Age            | <7years   | 431                   | 84                    | 19.94 | 0.66            | 0.416      |
|                | >7years   | 717                   | 126                   | 17.57 |                 |            |
| Body Condition | Fat       | 99                    | 12                    | 12.12 | 3.3             | 0.347      |
|                | Medium    | 243                   | 47                    | 19.34 |                 |            |
|                | Lean      | 385                   | 76                    | 19.74 |                 |            |
|                | Very Lean | 421                   | 75                    | 17.81 |                 |            |

### 3.1.5. Verminous pneumonia

Prevalence of verminous pneumonia among the cattle examined is shown in table 5. Prevalence of verminous pneumonia significantly ( $p < 0.05$ ) varied with the age of the cattle, but not with the body condition of the cattle. Meaning, the disease was more likely to occur among the young cattle, aged <7 years, than older cattle, aged >7 years.

Table 5. Prevalence of lesions of parasitic pneumonia.

|                | Variables | No. of cattle Examined | No. of positive Cases | %    | X <sup>2</sup> -value | p-value |
|----------------|-----------|------------------------|-----------------------|------|-----------------------|---------|
| Age            | <7years   | 431                    | 21                    | 4.9  | 0.66                  | 0.014   |
|                | >7years   | 717                    | 16                    | 2.23 |                       |         |
| Body Condition | Obese     | 99                     | 1                     | 1.01 | 5.016                 | 0.17    |
|                | Fat       | 243                    | 4                     | 1.64 |                       |         |
|                | Medium    | 385                    | 16                    | 4.15 |                       |         |
|                | Lean      | 421                    | 16                    | 3.8  |                       |         |

### 3.2. Assessment of economic loss

A total of 990 lungs (86.2%) were condemned or partially trimmed due to pulmonary disease and lesions with an economic loss of 7,920 Ethiopian Birr (ET Birr). This loss was calculated from the mean retail market price of a cattle lung, ranging from 6 ET Birr to 10 ET Birr (mean 8 ET Birr) and the total number of lungs condemned during the study period. Annual economic loss due to lung condemnation was determined by considering annual slaughter rate of cattle and prevalence of lung lesions and was estimated to be 65,000 ET Birr, which is equivalent to US\$ 3,095 with the current currency conversion rate of US\$ 1 equal to 21 ET Birr.

## 4. DISCUSSION

The current prevalence of pulmonary lesions was 86.3% which is in line with that of Abayneh (1999) who studied at Asella abattoir in Oromian region of Ethiopia where the prevalence was 83.87%. This indicates that appropriate control measures were not taken in the study area. According to Samuel (2007), prevalence of pulmonary lesions in Diredawa abattoir, Eastern Ethiopia, was 98% with 5% pulmonary fibrosis, 34.6% pneumoconiosis, 38.8% pulmonary hydatidosis and 0.96% parasitic bronchitis. Amene et al. (2012) also reported similar results from Jimma in western Ethiopia. The variation in the present study may be due to agroecology of the area, different management practices and difference in species of the animals. Some diseases are endemic to specific agroecology where the causative agent or its intermediate host may find favorable conditions

Moderate to high prevalence of the lesions was reported by Rahman et al. (2003) in Bangladesh, with pulmonary congestion 61.53%, pulmonary emphysema 25%, parasitic pneumonia 29.85% and pulmonary hydatidosis 25%, which varied with the present result. The highest prevalence of pulmonary congestion was distributed into all lobes of the lung and in animals with good body

condition. This may be due to poor pre-slaughter treatments, improper stunning and improper bleeding.

In this study, the rate of infection leading to pulmonary emphysema and parasitic pneumonia varied significantly ( $p < 0.05$ ) with age of animals. While the highest percentage of pulmonary emphysema was found among the older cattle ( $>7$  years), which may be due to exposure of the animals to different etiologic factors throughout their long life, the highest prevalence of parasitic pneumonia was found among the young cattle ( $<7$  years). The latter could be because the young cattle were exposed to pasture without previous exposure to the diseases.

In this work a trial was also made to relate body condition score with prevalence of pulmonary lesions. While the prevalence of pulmonary congestion was highest among fatty cattle, which might be due to the strangling during slaughtering and improper bleeding, the prevalence of pulmonary emphysema and pulmonary abscesses were higher among cattle with poor body conditioned. The right side of the lung was free quietly afforested than the left because the right main bronchus follows the direction of the trachea more closely at its bifurcation (Rahman et al., 2003). There was no significant difference ( $p > 0.05$ ) in the prevalence of pulmonary hydatidosis and parasitic pneumonia with body condition score.

Radostits et al. (2000) reported the occurrence of verminous pneumonia mostly involved diaphragmatic lobes of the lung. This is similar with that of Samuel (2007) who studied pulmonary lesions in camel in eastern Ethiopia. Kassahun (2008) investigated the occurrence of hydatidosis in Mekelle abattoir and reported a prevalence of 32.1%, out of which 49.45% were found in lungs. It has been stated that relatively softer consistency of lungs allows easier development of pressure cyst and fertility of hydatid cyst may show a tendency to increase in advanced age of the host. This may be related with reduced immunological compatibility of the hosts at their age of infection (Hubbert et al., 1975). Finally, the observation made on the present investigation clearly proved that pulmonary lesions and diseases are some of the major respiratory diseases having economic and public health importance. These lesions and diseases caused significant economic loss due to lung condemnation and public health importance like pulmonary abscess in bovine tuberculosis and pulmonary hydatidosis. Further study is recommended on a larger scale with specific data about the origin of animals slaughtered.

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