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## RESEARCH ARTICLE

# THE PREVALENCE AND ECONOMIC IMPORTANCE OF BOVINE FASCIOLOSIS AT DEBRE BIRHAN MUNICIPAL ABATTOIR

**[1,*]Feleke Eriso and [2]Girma Deneke**

[1]Department of Biology (Biomedical Division), College of Natural and Computational Sciences, Dilla University, Dilla, Ethiopia
[2]Department of Biology, Hailemariam Mamo Preparatory Secondary High School, Debre Birhan, Ethiopia

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**ABSTRACT**

**Background:** *Fasciola hepatica* is a parasite of herbivorous animals (sheep, goat, and cattle), living in the biliary passages of the liver and it also infects humans. *Fasciola gigantica* is the largest of human liver and lung flukes. Both of these parasitic flat worms cause the disease termed fasciolosis or fascioliasis in herbivorous animals as well as in humans. The prevalence of *Fasciola gigantica* does overlap with that of *Fasciola hepatica*. The key objectives of this study were to assess the prevalence rate of bovine fasciolosis and dealing with the consequences & the associated issues of interest.
**Method:** Information from the sample animals was collected by observation and palpation during antemortem examination of each slaughtered animal. Date that the cattle entered the Debre Birhan municipal abattoir, age, sex, breed, and body condition of each individual cattle was recorded. Postmortem examination of liver and associated bile ducts were carefully accomplished by visualization and palpation of the entire organ followed by transverse opening of the organ across thin sections. The livers of 400 randomly selected cattle were examined.
**Result:** Out of 400 cattle examined 261 (65.25%) cattle were confirmed positive for *Fasciola* species.
**Conclusion:** *Fasciola hepatica* and *Fasciola gigantica* were the causative agents of bovine fasciolosis in and around Debre Birhan. Poor nutrition & resistance of the livestock, types of nonproductive breed and seasonal occurrence of these infectious parasites together with nonproductive husbandry practices worsen the effects of fasciolosis. Assessment of human fasciolosis must be executed in & around Debre Birhan.



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## INTRODUCTION

*Fasciola hepatica* is a parasite of herbivorous animals (sheep, goat, and cattle), living in the biliary passages of the liver and it also infects humans. *F. gigantica* is the largest of human liver and lung flukes. The adult worms of both *F. hepatica* and *F. gigantica* are large leaf-shaped flukes. Both of them are parasitic flat worms of the class Trematoda which cause fasciolosis (fascioliasis). The prevalence of *F. gigantica* does overlap with that of *F. hepatica*, and the two species are so closely related in terms of genetics, behavior, morphological, and anatomical structures. *F. hepatica* (mainly sheep liver fluke) and *F. gigantica* (mainly of cattle) cause fasciolosis in humans. The life cycle of *F. gigantica* and *F. hepatica* is as follows:

***Corresponding author:*** **Feleke Eriso,**
Department of Biology (Biomedical Division), College of Natural and Computational Sciences, Dilla University, Dilla, Ethiopia.

Eggs (passed with feces) ⟶ eggs hatch ⟶ miracidium miracidium infects snail intermediate host ⟶ sporocyst (parthenogenesis in 24 hours) ⟶ redia ⟶ daughter redia ⟶ Cercaria (gets outside the snail) ⟶ encysted metacercaria (on aquatic plants) ⟶ infection of the final hosts (humans, sheep, or cattle) with metacercaria ⟶ adult stage produces eggs. The livelihood production at the farmer level as much as 70% of cash income is generated from livestock and around 80% of the pastoral household income depend on livestock (Adedokun *et al.,* 2008). The dominant economic feature of Ethiopia is the agriculture sector of which livestock is a very important and essential component (Zewdie *et al.,* 2011). Eventhough a large number of livestock is present in Ethiopia, the level of productivity is low due to several limiting factors such as the low genetic potential of the cattle, poor nutrition, low reproductive performance, inadequate management, and high disease prevalence (Alula *et al.,* ). Out of the diseases caused against livestock, fasciolosis is the most significant one that reduces productivity and fertility of livestock (Alula,

2013). Fasciolosis is a parasitic disease mainly of cattle, sheep, goats including humans caused by two major species, namely: F. hepatica and F. gigantica which are characterized by weight loss, anemia and hypoproteinemia (Berihun, 2012). In tropical areas livestock health problem is high due to environmental factors like high temperature and humidity, topography structure of sloppy area exposed to flood so as to increase rate of infections and drought. As a result, feed availability is limited and low vegetation coverage is the resultant outcome (Gebremedhin, 2007). Fasciolosis is distributed in countries with number of cattle and sheep production. Continents where fasciolosis in livestock was repeatedly reported were: America, Australia, Europe, Asia and Africa (Lofty *et al.,* 2002). The key objectives of this study were to assess the prevalence rate of bovine fasciolosis and dealing with the consequences as well as the associated economic & scientific issues of interest.

## MATERIALS AND METHODS

### Description of the study area

The study was conducted from July, 2015 to June, 2016 at Debre Birhan Municipal Abattoir which is situated at about 1 Km southwest of the Debre Birhan Town on the road to Jihur Town. Informal and intermittent information about the prevalence rate of fasciolosis was followed up/assessed in 2017 at the same municipal abattoir and the prevalence rate of the parasite was found to be persistently the same. Debre Birhan is the Capital Town of North Shoa Zone, Amhara Region. It is at 130 kilometers northeast of Addis Ababa on the main road to Dessie. Debre Birhan receives an annual average rainfall of 731 to 1068 mm and has an annual temperature range of 6 to $20^0$ C (Zewdie *et al.,* 2011).

### Data gathering methods

Information from the sample animals was collected by observation and palpation during antemortem examination of slaughtered animal. Date that the cattle entered the abattoir, age, sex, breed and body condition of each individual cattle was recorded. Body scoring of the cattle was categorized based on the method of Nicholson and Butter cited in Ephrem *et al* of 2012 and identified as:

- medium,
- fat, and
- obese.

Each slaughtered sample was clearly labeled with animal's identification based on the code given by butcher. Postmortem examination of liver and associated bile duct was carefully accomplished by visualization and palpation of the entire liver followed by transverse opening of it across thin left section in order to approve the case (Hylegebriel *et al.,* 2012). When the adult flukes were found they were isolated with forceps and preserved in a bottle of 10% formalin. When a drop of 10% formalin (i. e., into which the adult *F. hepatica* & *F. gigantica* that had been taken from bile ducts & placed) was observed under the high power objective, plenty of *Fasciola* eggs were seen and recorded with the help of digital camera. That was so because so many *Fasciola* eggs were adhering to the wet body surfaces of the adult flukes isolated from the bile ducts of the liver samples. The adults and the egg were healed & colored using a computer.

### Study population

The prevalence of fasciolosis in Debre Birhan abattoir was assessed by examining samples' liver from randomly selected 400 cattle in the Debre Birhan municipal abattoir. Selection was carried out among local, cross and exotic breeds of different body condition and sex groups of the cattle. The age of the sampled cattle was decided based on the dental formula (Jenny, 2009), sex, breed and body condition were considered carefully.

### Study design

A cross sectional and retrospective study was conducted at Debre Birhan municipal abattoir to determine the rate of the prevalence and the economic significance of bovine fasciolosis by using postmortem examination of liver of each slaughtered cattle. During the study period special attention was given to the liver of each slaughtered animal and carefully examined by visualization and palpation of the entire liver that was followed by transverse incision of the organ across tinny left lobe of liver to confirm the problem (Jenny, 2009).

### Sample size determination

The sampled cattle were selected by using simple random sampling method. To determine the sample size, an expected prevalence of 50% was taken into consideration since there is no recorded prevalence of bovine fasciolosis in Debre Birhan municipal abattoir. Absolute precision of 5% and confidence level of 95% was taken. The desired sample size for the study was calculated using the formula given by Thursfield cited in Ephrem *et al* of 2012. It was worked out as follows.

$N = (1.96^2 P_{exp}) (1-P_{exp})/d^2$

Where

$P_{exp}$ = expected prevalence

d = absolute precision

N = sample size

$N = (1.96^2 * 0.5) (1-0.5)/(0.5) = 384$

Hence, the sample size of the animals was 384, but in order to increase the precision of the result a total of 400 cattle was examined.

### Data management and analysis

The raw data collected from the current study was entered into Microsoft excel database organized and arranged using Microsoft Excel spread sheet computer program and would be analized by SPSS Version 20. Chi-square ($X^2$) had been used to determine the statistical association between infection rates and types of species, age, sex, breed, intensity of pathological lesion and an impartive Pie Chart was employed in the integration of results.

A statistically significant association between variables was considered to exist if the calculated p-value was less than 0.05 with 95% confidence level.

## RESULT S

**Table 1. The prevalence of fasciolosis based on breed**

| Breed of cattle | Number of examined cattle | Number of infected cattle | Prevalence rate | $X^2$ | P-value |
|---|---|---|---|---|---|
| Local | 328 | 210 | 64.02% | 4.602 | 0.596 |
| Cross | 58 | 41 | 70.69% | | |
| Exotic | 14 | 10 | 71.43% | | |
| Total | 400 | 261 | 65.25% | | |

**Table 2. The prevalence of fasciolosis based on sex**

| Sex of cattle | Number of examined cattle | Number of infected cattle | Prevalence in percent | $X^2$ | P-value |
|---|---|---|---|---|---|
| Male | 355 | 231 | 65.07% | 0.274 | 0.965 |
| Female | 45 | 30 | 66.67% | | |
| Total | 400 | 261 | 65.25% | | |

**Table 3. Prevalence of fasciolosis based on body condition**

| Body condition | Number of examined cattle | Number of infected cattle | Prevalence in percent | $X^2$ | P-value |
|---|---|---|---|---|---|
| Medium | 171 | 128 | 74.85% | 29.63 | 0.000 |
| Fat | 172 | 111 | 64.53% | | |
| Obese | 57 | 22 | 38.6% | | |
| Total | 400 | 261 | 65.25% | | |

**Table 4: Prevalence of fasciolosis based on the intensity of pathological lesion**

| Intensity of pathological lesion | Number of cattle infected with *Fasciola* species | Prevalence in percent | $X^2$ | P-value |
|---|---|---|---|---|
| Lightly affected liver | 95 | 23.75% | 419.172 | 0.000 |
| Moderately affected liver | 90 | 22.50% | | |
| Severely affected liver | 76 | 19% | | |
| Total | 261 | 65.25% | | |

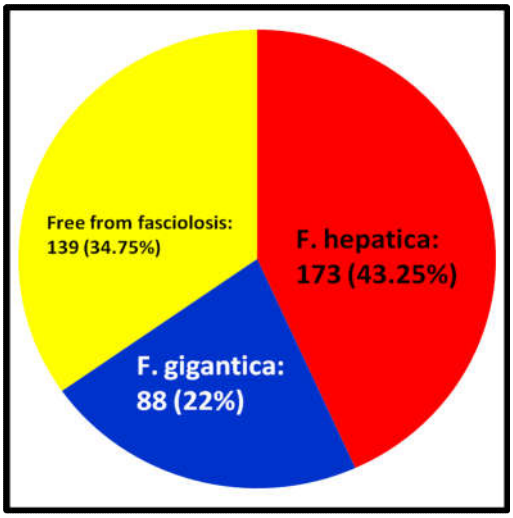


**Figure 1. The Pie Chart showing the numerical & its percentile prevalence rate in bracket of *Fasciola hepatica, Fasciola gigantica* and those of cattle free from fasciolosis in the total sample size of 400 cattle examined at Debre Birhan municipal abattoir. Out of the 400 cattle examined 261 cattle were found infected with *Fasciola* species. The number of cattle positive for *F. hepatica* infection was 173 (43.25%) whereas that positive for *F. gigantica* was 88 (22%) and the number of the cattle (out of 400 cattle examined) that were free from infection with Fasciola species were 139 (34.75%).**

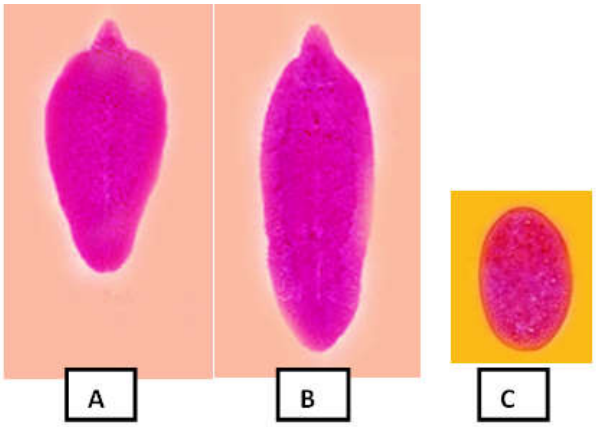


**Figure 2: The adults & egg of *Fasciola* species isolated from the bile ducts of infected liver of cattle. (A) *Fasciola hepatica*; (B); *Fasciola gigantica*; (C) *Fasciola*, egg. In morphology, *F. hepatica* has 2 prominent shoulders with converging margins & small size whereas *F. gigantica* has less prominent shoulders with parallel margins and larger size than that of *F. hepatica*.**

## DISCUSSION

Bovine fasciolosis exists in almost all regions of Ethiopia. However, the prevalence, epidemiology and *Fasciola* species involved vary with locality that were caused by the variation in the climate and ecological conditions such as altitude, rain fall, temperature, livestock management system (Shiferaw *et al.,* 2011). The prevalence of fasciolosis in Ethiopia varies from 11.5% in low land area to 87% in high land area. The low lying areas in the high lands have poor drainage, which favors the development of parasites (Hylegebriel *et al.,* 2012). The current study of postmortem examination indicated that the prevalence of bovine fasciolosis at the Debre Birhan municipal abattoir was 65.25%, which was much lower than the documented prevalence rates of bovine fasciolosis at other municipal abattoirs of Ethiopia. For instance, at southeast of Ethiopia the prevalence rate was worked out to be 74.8% (Manyazewal *et al.,* 2013). This might be associated with difference of environmental and topographic conditions of the study area. On the other hand, the current study was comparable with previous studies, 60.42% at Andessa municipal abattoir (Asressa, 2012). However, much lower prevalence rates were also noted in different parts of Ethiopia, such as 48.53% at Jima municipal abattoir (Tadele, 2007), 45.25% at Hawassa municipal abattoir (Shiferaw *et al.,* 2011), 41.41% at Woreta municipal abattoir (Biniam *et al.,* 2012), 39.8% at Hashim Nur's Ethiopian livestock and meat export industrialized abattoir in Debre Zeit (Yemisrach, 2012), 31.51% at Ginnir District (Atnafe *et al.,* 2012), 25.2% at Dessie municipal abattoir (Ephrem *et al.,* 2012), 22.76% at Mekele municipal abattoir (Hylegebriel *et al.,* 2012), 21.5% at Adigrat municipal abattoir (4), 20.3% at Addis Ababa municipal abattoir (Kassaye *et al.,* 2012), 45.3% at the Bahir Dar municipal abattoir (Ayalew, 2013), 43.25% at Quarit District (Alemnew *et al.,* 2013), 24.44% at Dire Dawa municipal abattoir (Mebrahatu, 2013), 21.9% at Nekemte municipal abattoir (Alula *et al.,* 2013), 20.8% Bedelle municipal abattoir (Yosef *et al.,* 2014). This could be due to difference in altitude, topography and weather conditions or creation of awareness to the livestock owner how to keep their cattle healthy, protect their cattle from reaching infected area, keeping pastures dry and eliminating surrounding

contaminated vegetation which could be a suitable medium for *Fasciola* infection and the use of anthelminths to treat infected animals by veterinary health technicians. Until recently human cases of fasciolosis occurred occasionally but now, are increasingly reported from Europe, America, Oceania, Asia and Africa (Mas-Coma *et al.,* 2005). WHO estimated that 2.4 million people were infected with *Fasciola* species in more than 70 countries worldwide, with several million being at risk. No continent is free from fasciolosis and is likely that where animal cases are reported, human cases also existed (Lofty, 2003). There were only a few cases reported, human fasciolosis in Ethiopia, as the disease mostly affects animals.

However, the need to be aware of the possibility of occurrence of this disease in human cannot be bypassed. The retrospective study conducted in different health centers, and zonal hospital in and around Debre Birhan showed that there were no recorded human *Fasciola* cases. No research work has been conducted about human fasciolosis in Debre Birhan and its surrounding. Physicians and laboratory technicians who work in different health centers and hospitals explained that they know the way of transmission of human fasciolosis theoretically; however, it is not focused on. Human fasciolosis is not targeted at in the study area because of:

- Lack of research conducted about the prevalence and impact of human fasciolosis in and around Debre Birhan,
- Human fasciolosis is not listed as a disease focused on in any of the human standard treatment
- Guide line for health centers and hospitals, and
- The impact of human fasciolosis might not be serious, as in the patients infected with other helminthes.

*Fasciola hepatica* occur mainly in sheep and cattle rearing areas of temperate climate particularly in Europe, China, Africa, Middle east, South America (Ashrafi *et al.,* 2006). The current prevalence rate of bovine *F. hepatica* at Debre Birhan municipal abattoir has been confirmed to be 43.25% which is almost similar to the prevalence rate of 42.7% at Adigrat District (Berihun, 2012), 42.6% at Abdlla Village (Manyazewal, 2013).

However, it was highly lower than the results reported from investigative studies conducted in different parts of Ethiopia, for instance, 67.14% at North Gondar (Yilma, 2000), 58.9% at Hawassa municipal abattoir (Rahmato, 2010), 60.3% at Assela municipal abattoir (Shiferaw *et al.,* 2011), 65.9% at Dessie municipal abattoir, 53% at Mekelle municipal abattoir (Hylegebriel *et al.,* 2012), 89.7% at Bahir Dar municipal abattoir (Fikirtemariam *et al.,* 2013), 69.23% at Ambo municipal abattoir (Diriba *et al.,* 2015). There were also other studies conducted in other different parts of Ethiopia in which the prevalence rates were lower than that of the current study at Debre Birhan municipal abattoir. These include, 29.49% at Jimma municipal abattoir (Tadele, 2007), 13.9% at Adawa municipal abattoir (Mihreteab *et al.,* 2010), 15.2% at Addis Ababa municipal abattoir (Kassaye *et al.,* 2012), 39.13% at Quarit District North-West Ethiopia (Alemnew *et al.,* 2013), 16.89% at Dire Dawa municipal abattoir (Mebrahatu *et al.,* 2013), 14.1% at Nekemte municipal abattoir (Alula, 2013), and 30.5% at Hossana municipal abattoir (Bekele *et al.,* 2014). *Fasciola gigantica* is found in Africa, South-East Asia, USA and its intermediate host is a fresh water snail. Infection with this species is associated with livestock drinking from snail infected watering places as well as grazing wet land (Shiferaw *et al.,* 2011). The prevalence rate is high in areas surrounding large ponds in which *Lamnae natalensis*, the intermediate host of *F. gigantica*, is found. The distribution of *F. gigantica* was mainly localized in the western humid zone of Ethiopia that encompasses approximately one fourth of the nation (Fikirtemariam *et al.,* 2013). As many research studies indicated, *F. gigantica* is an important parasitic disease mainly in tropical and subtropical countries which limited the productivity of ruminants particularly that of cattle. *F. gigantica* exists below 1800 meters above sea level (m.a.s.l.) and prevalent below 1200 masl.

Eventhough, Debre Birhan municipal abattoir is located at 2840 masl, many of the livestock transported to Debre Birhan municipal abattoir originated from different agro-ecological areas like Shoa Robit which is located below 1280 masl and has suitable environment for the propagation of *Lamnae natalensis* and the cattle can be infected with *F. gigantica*, so the current study indicated that the prevalence rate of *F. gigantica* at Debre Birhan municipal abattoir was 22% which was greater than the prevalence rate of 5.25% at Nekemte municipal abattoir (Alula *et al.,* 2013), 5.56% at Dire Dawa municipal abattoir (Mebrahatu, 2013), 11.11% at Jima municipal abattoir (Tadele, 2007), 7.7% at Adawa municipal abattoir (Mihreteab, 2010), 10.6% at Hawassa municipal abattoir (Rahmato *et al.,* 2010), 18.25% at Dessie municipal abattoir (Ephrem *et al.,* 2012), and 13.9% at Bahir Dar municipal abattoir (Ayalew, 2013). Higher prevalence rates of F. gigantica than that of Debre Birhan municipal abattoir do exist in Ethiopia; for instance, 53.75% at Mekelle municipal abattoir (Hylegebriel *et al.,* 2012), and 86.62% at Ambo municipal abattoir (Diriba, 2015). The prevalence rate of fasciolosis based on the sex of the slaughtered cattle was statistically insignificant ($P>0.05$), which indicated that absence of relationship between the sex of the cattle and the prevalence rate of fasciolosis due to exposure of male and female to similar ecological condition and used similar management system without considering their sex. As the result in Table 2 indicated, the prevalence of bovine fasciolosis was 65.07% in male and 66.67% in female; similar prevalence rate relationship of male 41.43% and female 41.38% was recorded at Woreta municipal abattoir (Biniam *et al.,* 2012) and at Bedelle municipal abattoir the infection rate in the population of males was 20.88% and in that of females was 20.79% (Yosef *et al.,* 2014). Other study results indicated that the presence of very large gap between the prevalence rate of fasciolosis in male and female. At Mekelle municipal abattoir the prevalence of bovine fasciolosis in male was 22.97% and in female was 9.0% (Hylegebriel *et al.,* 2012), at Lemo District in male was 41.4% and in female was 30.6% (Bekele *et al.,* 2014); this might be due to economic importance given by the local society for female cattle by keeping in protected areas and in addition to that, the abattoir rule prohibited to slaughter young fertile female in the abattoir without the permission of veterinary physician.

The economic loss of livestock due to fasciolosis throughout the world was enormous and these losses are associated with the reduction in weight, milk, increase in susceptibility to secondary infection and cost for treatment. The current prevalence of fasciolosis based on body condition of the livestock were: 74.85%, 64.53%, and 38.6% for medium, fat, and obese body respectively which was nearly similar to prevalence rates registered at Assela municipal abattoir being:

- 75% for thin body condition,
- 49% for medium body condition, and
- 40% for good body condition (Shiferaw *et al.,* 2011), whereas at Mekelle municipal abattoir for poor, medium, good body conditions were 43.7%, 18.4%, and 8.75% respectively (Hylegebriel *et al.,* 2012).

Fasciolosis causes economic losses in livestock as the result of mortalities, abortions, retarded growth, reduced meat and milk production, condemnation of infected livers and emaciated carcass (Kithuk *et al.,* 2002). The liver condemnation and carcass weight loss due to fasciolosis was computed based on the information obtained during postmortem examination and interview from different butchers of meat retailer about the current price of one liver and one killo gram of meat. The analysis was done for liver condemnation and body weight reduction due to *Fasciola* infection.

## Conclusion and Recommendation

### Conclusion

*F. hepatica* and *F. gigantica* are the causative agents of bovine fasciolosis in and around Debre Birhan. Poor nutrition & poor resistance of the livestock, types of nonproductive breed and seasonal occurrence of these infectious parasites together with nonproductive husbandry practices worsen the effects of fasciolosis. This study project had been able to report that *F. hepatica* was the most important parasite of cattle with the prevalence rate of 43.25% whereas *F. gigantica* existed with a lower prevalence rate of22% in & around Debre Birhan. Human fasciolosis has not been reported in and around Debre Birhan due to the low yield of the diagnostic eggs of the two *Fasciola* species in stool examination and lack of awareness. The most important negative effects of fasciolosis in the study area are:

- Condamnation of liver,
- Losses in productivity due to death and loss of weight, and
- Reduction of milk production. In general, fasciolosis is one of the major prevalent obstacles for livestock industry in Ethiopia by causing remarkable direct or indirect economic losses at different parts of the country, particularly in Debre Birhan and its surrounding woredas.

### Recommendations

- Avoid using untreated livestock feces as fertilizer,
- Not allowing cattle to graze in swampy areas and drink contaminated water,
- Not allowing human consumption of contaminated vegetable and meat,
- Making farmers aware about the preventive measures against fasciolosis for the better health care of their livestock,
- Standard regulations and meat inspection policies should be formulated,
- Improving of the veterinary service and infrastructure in prevalence area with provision of modern anthelminthics,
- Effective drainage system should be practiced in order to control the snail intermediate host, and
- Further study about human fasciolosis in and around Debre Birhan must be executed/carried out by well trained & experienced experts.

### Conflict of interest

We confirm that we don't have any competitive conflict of interest with anybody.

### Financial support

The financial support to cover the cost of this study project was given by Dilla University

### Ethics

Ethical permission/clearance to perform the research work to contribute to the well-being of livestock & human subjects was obtained from Dilla University, and the Administrative Office of Debre Birhan Municipal Abattoir.

### Authors' contributions

The two authors, Feleke Eriso and Girma Deneke, have been equally involved in the task of producing this article.

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