Ethiopian Veterinary Journal (Ethiop. Vet. J.)

Objectives and Scope

The Ethiopian Veterinary Journal (Ethiop. Vet. J.) is a multidisciplinary peer-reviewed journal intended to promote animal health and production of national and regional/international importance. The journal publishes review articles, original research articles, short communication as well as technical notes in English. Under special circumstances, articles in Amharic may be considered for publication.

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Prevalence and identification of ectoparasites on indigenous chickens in Seharti-Samre District, Tigray, Northern Ethiopia

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Abstract

A cross sectional study was conducted from February 2014 to February 2015 to estimate the prevalence of ectoparasites and to assess risk factors in indigenous free scavenging chickens in three sub-districts of Seharti-Samre District, northern Ethiopia. Physical examination, hand picking for visible parasites, skin scraping and laboratory based identification of collected parasites were employed on systematically selected 570 indigenous chickens. An overall prevalence of 68.6% (391/570) ectoparasites with a specific prevalence of 44% (251/570), 14.4% (82/570) and 10.2% (58/570) for Echidnophaga gallinacea, Argus persicus and mixed infestations, respectively were recorded. Prevalence of A. persicus, E. gallinacea and mixed infestation showed statistically significant variation between seasons (OR=2.21, 95%, CI=1.539-3.178), housing in kitchen (OR=3.33, 95%, CI=2.0228-5.486) and main house (OR=3.19, 95%, CI=1.910-5.304); age group of birds. The odds of ectoparasites infestation were 3.42 and 7.57 times higher for chick and adults compared with the growers. The current study indicated high prevalence of ectoparasites in backyard poultry management system in the study area. E.gallinacea was found to be the most prevalent ectoparasites identified followed by A. persicus. Designing and implementation of appropriate ectoparasite control measures seems mandatory in order to mitigate economical losses due to ectoparasite infestation.

Keywords: Backyard; Ectoparasites; Poultry; Prevalence; Sehart-samre,

Introduction

Village chicken production has a fundamental role in capital build up, poverty, malnutrition and hunger reduction among the resource poor households in developing countries. Global poultry population has been estimated to be about 16.2 billion, with 71.6% in developing countries, producing 67,718,544 metric
tons of chicken meat and 57,861,747 metric tons of hen eggs (Gueye, 2005). Worldwide, poultry meat and egg production accounts for more than 30% of all animal protein (Permin and Pedersen, 2000). The International Food Policy Research Institute (IFPRI, 2000) has estimated that by year 2015 poultry accounted for 40% of all animal protein and they were the available asset to local populations throughout Africa and they contribute to food security, poverty alleviation and promote gender equality, particularly in rural Africa where the majority of the poor people reside. In addition to that village poultry can provide the start of the owner climbing “livestock ladders from small livestock to large livestock species production (Dolberg, 2003). This is because of their good scavenging behaviour, low input requirements for production, short generation intervals, and good adaptation to harsh environments (Besbes, 2009).

In Ethiopia, poultry production is one of the economically important agricultural activities. The recent livestock population estimates that Ethiopia has about 59.50 million poultry of which Tigray region has 5.74 million poultry (CSA, 2017). Ethiopian poultry production systems comprise both traditional and modern production systems, and contribute 98.5% of the national egg and 99.2% poultry meat production (Dessie et al., 2002). More than ninety percent of the national poultry population consists of indigenous breed types (Indigenous, 90.85%; Exotic, 4.39%; Hybrid, 4.76%) (CSA, 2017).

Despite their significant roles, poultry have received little attention in almost all the production systems. Their productive performance is disproportional with their size. Although their low performance has masked their potential, the sector boosts the living standards of chicken owners and contributes to rural developments in Ethiopia. The low performance of poultry has been attributed to prevalence of diseases, particularly external parasites (Nyaile et al., 2003), predators, low genetic potential, limited feed resources, and limited skill in management practices (Sonaiya, 2000; Dana et al., 2010; Yemane et al., 2013; Zewdu et al., 2013).

Recently, attempts are underway to enhance the poultry productivity and optimize the contribution of chickens to the national economy despite the negative impact of pathogens. A lot of studies have been conducted on poultry health and their economic and health values. However, most of the studies have focused on viral diseases such as Newcastle disease, infectious bursal disease, fowl pox, avian influenza and Marek’s disease among other diseases (Njunga, 2003). The extension messages that were developed on parasites are also mainly focused
for endoparasites. Ectoparasites have received less attention in most reports and have been considered as side line agricultural activity (Njunga, 2003). Ectoparasites do have an effect on poultry health directly by causing irritation, discomfort, tissue damage, blood loss, toxicities, allergies and dermatitis which in turn alleviate quality and quantities of meat and egg production. They also act as mechanical or biological vectors transmitting number of pathogens (Fabiyi, 1996). Hence, the aims of this study were to estimate the prevalence of ectoparasites, identify the parasitic fauna and the host related risk factors in indigenous free scavenging chickens in the study area.

Materials and methods

Study area description

The study was conducted in Seharti-Samre district of south eastern Tigray regional state, Ethiopia. Seharti-Samre is located at 36°27’ E and 39°59’ E longitudes, and 12°15’ N and 14°57’ N latitudes. The elevation of the district ranges between 1470 and 2370 meters above sea level with mean annual rain fall of 610.5 (351-870) mm (June to August, summer season) and annual average temperature of 22.5°C (15-30°C). The district has a total of 18 sub-districts possessing 65 peasant associations. The population of the district is 151,817 (75,511 male; 76,306 females). In the current study three sub-districts namely, Gijet, Metkel limat and Samre were included purposefully based on the availability of indigenous scavenging poultry population in the study area. The total households of the district are 39,004 (31,083, male headed; 7,921 female headed) among which the study sub-districts possess 4,061 (Metkel limat 1,622, Samre 1,256, Gijet 1,183). The total numbers of poultry in this District are 112,047 among which the study sub-districts posses 17,740 (Samre, 5,265, Gijet, 4,627 and Metkel limat 7,848) (Seharti-samre district annual report, 2015).

Study population and sampling procedure

The study was carried out from February 2014 to February 2015, on a total of 570 chickens managed under backyard production system by collecting data relating with ectoparasitism in the study area. The sample size was determined based on the formula given by Thrusfield (2005) for simple random sampling methods using an expected prevalence of 50% at 95% level of confidence and 5% desired precision. Accordingly, a total of 384 chickens were required.
for this study. However, 570 chickens were systematically selected to increase precision.

Systematic sampling method was applied after sampling interval was determined using the formula \( K=N/n \). Where: \( N \) = represents estimated total chickens for backyard farm in sampling frames; \( n \) = represents allocated sample size and \( K \) = interval of household to be sampled (Pfeiffer, 2002). Accordingly, a chick was caught and examined at every 31 household intervals. Chickens of both sexes were included in the study and they were subdivided into chicks (aged between 1-3 months), growers (between 3-9 months) and adults (aged greater than 9 months) (Maina, 2005). Age was determined subjectively based on the size of crown, length of spur and flexibility of the xiphoid cartilage (Magwisha et al., 2002).

**Collection of ectoparasites and identification**

Ectoparasites were collected, preserved in labeled universal bottles using 70% alcohol and transported to parasitology laboratory in College of Veterinary Medicine, Mekelle University. Parasites were then identified against their morphological characteristics and entomological keys using light microscope (Soulsby, 1982; Walker, 1994; Wall and Shearer, 1997; Hogsette et al., 2003; Taylor et al., 2007; Richman and Koehler, 2007).

**Statistical analysis**

Collected data were entered into excel spread sheet of Microsoft office Excel 2010. Individual records and results of the field samples were coded and filled. The data was analysed using SPSS version 17. Descriptive statistics were employed for describing management practices. Logistic regression analysis was conducted to analyze strength of association of odd ratio (OR) at 95% confidence interval. In all analysis, p-value <0.05 was taken as statistical significance value.

**Results**

**Prevalence of ectoparasites**

An overall prevalence of ecto-parasite infestation of 68.6% (391/570) was recorded in the current study (Table 1). Among the identified parasites, flea
Echidnophagia gallinaceae was found with higher prevalence (44%) followed by ticks Argus persicus (14.4%) and mixed infestations of both species (10.2%).

Table 1. The overall prevalence of ectoparasites in the study area

<table>
<thead>
<tr>
<th>Species of ectoparasites</th>
<th>No. examined</th>
<th>No. infected</th>
<th>Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. gallinaceae</td>
<td>570</td>
<td>251</td>
<td>44.0</td>
</tr>
<tr>
<td>A. persicus</td>
<td>570</td>
<td>82</td>
<td>14.4</td>
</tr>
<tr>
<td>E. gallinaceae and A. persicus</td>
<td>570</td>
<td>58</td>
<td>10.2</td>
</tr>
<tr>
<td>Total</td>
<td>570</td>
<td>391</td>
<td>68.6</td>
</tr>
</tbody>
</table>

Distribution of poultry ectoparasites with respect to selected risk factors

Higher prevalence was recorded from adult and male compared to their counterpart (Table 2). The odds of ectoparasites infestation were 3.42 (AOR = 3.42; 95% CI=2.14-5.48) and 7.57 (AOR=7.57; and 95% CI= 4.57-11.48) higher for chick and adult, respectively compared with the growers. Infestation of birds living on partly isolated house, main house, kitchen and trees were 174/303(57.4%), 99/122(81.8%), 108/132(81.1%) and 10/13(76.6%), respectively. The risks of acquiring ectoparasites by poultry kept on kitchen and main houses were 3.3 (AOR=3.3; 95% CI=2.01-5.49) and 3.2 (AOR=3.2, 95% CI=1.9-5.3), respectively times more likely than chicken kept on partly isolated houses. Moreover, significantly higher burden of infestation was recorded in dry season (76.8%) compared with the rainy season (59.9%). The risk of acquiring ectoparasites during dry season was 2.21 (OR=2.21 and 95% CI=1.54-3.1) times more likely than wet season.
Table 2. Prevalence of ectoparasites on the basis of age, sex, housing and season

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. examined</th>
<th>No. positive (%)</th>
<th>Adjusted odd ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>grower</td>
<td>151</td>
<td>62 (41.1%)</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>chick</td>
<td>159</td>
<td>112 (70.4%)</td>
<td>3.4</td>
<td>2.14-5.48</td>
</tr>
<tr>
<td>adult</td>
<td>260</td>
<td>217 (83.5%)</td>
<td>7.6</td>
<td>4.57-11.48</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>159</td>
<td>112 (70.4%)</td>
<td>3.4</td>
<td>-</td>
</tr>
<tr>
<td>Female</td>
<td>151</td>
<td>62 (41.1%)</td>
<td>0.3</td>
<td>2.1-5.5</td>
</tr>
<tr>
<td>Housing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Partly isolated</td>
<td>303</td>
<td>174 (57.4%)</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>kitchen</td>
<td>132</td>
<td>108 (81.8%)</td>
<td>3.3</td>
<td>2.03-5.49</td>
</tr>
<tr>
<td>Main house</td>
<td>122</td>
<td>99 (81.1%)</td>
<td>3.2</td>
<td>1.91-5.30</td>
</tr>
<tr>
<td>Tree</td>
<td>13</td>
<td>10 (76.9%)</td>
<td>2.5</td>
<td>0.67-9.16</td>
</tr>
<tr>
<td>Season</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wet (Rainy)</td>
<td>277</td>
<td>166 (59.9%)</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Dry</td>
<td>293</td>
<td>225 (76.8%)</td>
<td>2.2</td>
<td>1.54-3.18</td>
</tr>
</tbody>
</table>

Prevalence based on ectoparasites species and their site of attachment

In the present study, higher burden of *E. gallinacea* was found on comb, wattles, and eyelids while higher burden for *A. persicus* was below the wing (Table 3).

Table 3. Prevalence rates of ectoparasites species and their predilection sites

<table>
<thead>
<tr>
<th>Attachment site</th>
<th>Distribution of ectoparasite Species</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>E. gallinacea</em></td>
</tr>
<tr>
<td>Comb</td>
<td>85 (14.9%)</td>
</tr>
<tr>
<td>Wattle</td>
<td>68 (11.9%)</td>
</tr>
<tr>
<td>Comb, wattle &amp; eye</td>
<td>91 (16%)</td>
</tr>
<tr>
<td>Beneath wing</td>
<td>1 (0.2%)</td>
</tr>
<tr>
<td>Comb, Wattle</td>
<td>6 (1.1%)</td>
</tr>
<tr>
<td>Total</td>
<td>251(44 %)</td>
</tr>
</tbody>
</table>
Discussion

The current study revealed that ectoparasite infestation was a common problem in the study site. The prevalence was found to be higher than previous reports such as 19.3% in Iraq (Al-Saffar and Al-Mawla, 2008). This variation could be due to difference on husbandry management, housing, community awareness, breed and drug intervention practices.

The prevalence of *E. gallinacea* in the present study was higher than what was previously reported by Mekuria and Gezahegn (2010), 16.5% in Wolayta Soddo. This discrepancy might be due to the agro-ecological variation of the study sites, community awareness in the different sites, husbandry and feeding system of the poultry production. Furthermore, the current prevalence of *A. persicus* was found to be higher than reports of 9.2% in Wolayta Soddo town in southern Ethiopia (Mekuria and Gezahegn, 2010) and 6.8% in Mosul, Iraq (Al-Saffar and Al-Mawla, 2008). Evermore, Swai et al. (2009) reported a very high prevalence (23.9%) of *A. persicus* in northern Tanzania. The variation could be due to difference on biosecurity, farming system and status of veterinary service. The most affected sites recorded in the current study were comb, beneath the wings, wattle and eye regions. This might be due to low distribution of feathers, soft and fleshy, and vascular favored for easy invasion by the ectoparasites. This finding was in agreement with the findings of Biu et al (2007) in Nigeria.

A statistically significant difference was observed in the prevalence of ectoparasites between male and female. This disagrees with Sabuni et al (2010) who reported that there was no significant difference in the prevalence rate of ectoparasites infestation between male (37.3%) and female (34.0%) in Kenya. This might be due to difference on management system. In the present study, highest prevalence was recorded in chicken kept in main house and kitchen. This might be due to the fact that they shared the ectoparasites from household materials, rodents, animals and humans. With regard to seasonal occurrence of the ectoparasites infestation, high infestation rate was observed in dry season (76.8%). This could be due to favorable time for multiplication of the parasites coupled with the limited community awareness to do season based strategic prevention and control approach in the area.
Conclusion

The current study indicated high prevalence of ectoparasites in backyard poultry in the study area. *E. gallinacea* was the most prevalent ectoparasite identified during this study followed by *A. persicus*. Age, housing condition and season were found to be associated with external parasites infestation on indigenous chickens in the study area. Control of poultry ectoparasites has received little or no attention from expertise and the community themselves. Hence, strategic control approaches targeting various age groups, type of housing system and season are recommended. Furthermore, detailed studies to investigate the exact economic and public health impact of the existing ectoparasites in the study area could help to develop a sustainable strategy for their prevention and control.

Acknowledgements

The authors are thankful to Mekelle University College of Veterinary Medicine for allowing their laboratory free of charge during sample processing and parasite identification. Sehart-samre district animal health unit staffs for their technical support and the community for their collaboration during the data collection are also acknowledged.

References


Survey on indigestible foreign bodies in the rumen and reticulum of cattle slaughtered at Nekemte municipal abattoir, Nekemte, Ethiopia

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Abstract

A cross sectional study was conducted on cattle slaughtered at Nekemte Municipal Abattoir, Nekemte, East Wollega, Ethiopia from November 2015 to April 2016. The objectives of this study were to estimate the prevalence and to identify the type of indigestible foreign bodies in the rumen and reticulum of slaughtered cattle in association with the hypothetical risk factors. Each compartments of stomach was opened carefully and thorough visual inspection was made for the presence of indigestible foreign bodies. Of the 384 randomly selected cattle, overall foreign body detection was recorded in rumen and reticulum of 67 (17.5%) the cattle examined. There was a higher prevalence of rumen and reticulum foreign bodies in female (25.4%) than in male cattle (15.4%) \((\chi^2=3.99, p < 0.05)\). From the three age groups examined, the prevalence was higher (23.4%) in animals in the old age group than the younger (20.4%) and adult groups (12%) \((\chi^2= 7.9096; p<0.05)\). Foreign bodies collected were of different types including plastic (31.34%), clothes (21.4%), calcified bodies (4.5%) and wires (4.5%). Foreign bodies weighing ≥300 grams were recorded in greater percentage 21(21.8%) in animals with poor body condition than those with medium 17(8.3%) and good 6(7%) body condition. This study revealed ingestion of different types of indigestible foreign bodies by cattle in the study area posing serious health problem for free grazing cattle. Hence, designing and implementation of appropriate solid waste disposal and management practice is strongly recommended to reduce the risk of ingestion of indigestible foreign bodies by cattle.

Keywords: Abattoir; Cattle; Foreign body; Nekemte; Reticulum; Rumen
Introduction

The occurrence of foreign bodies in the rumen and reticulum of cattle is commonly seen in developing countries primarily due to indiscriminate feeding habits, improper waste disposal in the environment, nutritional deficiency and poor management system around home (Singh and Nigam, 1981). Industrialization and mechanization further increased the incidence of foreign bodies in animals in urban and semi urban areas (Misk, 1999). Cattle kept in farm yards, stables close to human mechanical activities are disposed to swallow metallic, plastic and non-plastic objects such as nails and pieces of wires that have been carelessly left in their feeding areas. They are exposed to indigestible materials resulting in high economic losses (Misk, 1984; Jones, 1997; Semieka, 2010; Tesfaye and Chanie, 2012). Most of these foreign bodies were found mainly in the fore-stomachs and they are responsible for most pathological conditions (Tehrani, 2012). This may lead to various complications including ruminitis, rumen impaction, traumatic pericarditis and traumatic reticulo-peritonitis, even penetrate pleural cavity causing pleuritis and pneumonia, and into the pericardial sac causing pericarditis (Hailat et al., 1996). It may ultimately lead to rumen distension, absence of defecation, reduced feed intake, failure of the absorption of volatile fatty acids, reduced rate of weight gain, internal injury, the perforation of the wall of the reticulum which allows leakage of ingesta and rumen microflora which contaminates the peritoneal cavity, resulting in inflammation of the peritoneum and consequently death (Abdullah et al., 1984; Igbokwe et al., 2003; Remi-Adewunmi et al., 2004).

In Ethiopia, the occurrence of rumen and reticulum indigestible foreign bodies in cattle had been reported in different regions. Occurrence rate of 23%, 13.2%, 8.6%, 14.8%, 43.4%, 18.3%, and 35.7% were recorded by Tefaye et al (2012), Tefaye and Chanie (2012), Nugusu et al (2013), Berrie et al (2015), Negash et al(2015), Ushula  and Nana(2017), Mekuanint et al(2017), respectively. However, there is no published data on rumen foreign body of cattle in Nekemte area. Therefore, the objective of this study was to estimate the prevalence, type of foreign bodies and associated risk factors for indigestible foreign bodies in rumen and reticulum of cattle in Nekemte town.
Materials and methods

Study area

The study was conducted in Nekemte town which is located about 331 km west of Addis Ababa, the capital city of Ethiopia (Fig. 1). It has a latitude and longitude of 9°5′N 36°33′E and an elevation of 2123 meters above sea level. The mean temperature of the study area is between 33-35°C with more agricultural crops and people in the country (NMSA, 2013). The area receives long heavy rain season from June to September and short rain season from March to May and the minimum annual rainfall is approximately 1450mm and the maximum annual rainfall is 2150mm with the average rainfall of 1800mm. The major agricultural production seasonally harvested includes chickpea, wheat, teff, maize and other legume crops. The total livestock population of the zone is estimated to constitute 85,584 cattle, 14,702 sheep, 11,861 goats, 98,674 equine and 94,276 chickens (NDAO, 2013).

Figure 1. Map of study area (adapted from GIS desktop 10)
Study design

A cross-sectional study was carried out from November, 2015 to April, 2016 at Nekemte municipal abattoir in the study area. The study was carried out on 384 cattle which originated from different agro-ecological zones and kept under different management system. The study animals originated from Arjo-Gudatu, Wayu-Tuka, Uke, Diga, Bandira and Amuma districts. Animals were selected from the study population by using simple random sampling technique. During sampling the sex, age, body condition, and origin of animals were recorded. Classification of the body condition of animal was made according to a method previously described by Nicholson and Butterworth, (1986) with scale ranging from poor, medium and good. The age of the animals was grouped as (≤ 5 years), (5-10 years) and (≥10 years).

Sample size determination

The required sample size was determined based on the procedure described by Thrusfield (2005); using 50% expected prevalence of cattle foreign bodies in cattle in the area, and 5% desired absolute precision and at 95% confidence level. Accordingly, the total sample was determined to be 384.

\[ n = \frac{(1.96^2)P_{\text{exp}} (1-P_{\text{exp}})}{d^2} \]

Where: \( n \) = required sample size, \( P_{\text{exp}} \) = Expected prevalence and \( d \) = desired absolute precision. The sample size for this work was determined using 50% expected prevalence and 5% absolute precision at 95% confidence level using the above formula, the minimum of 384 cattle were intended to be sampled.

Ante mortem inspection: Animals presented for slaughter were subjected to ante-mortem inspection upon arrival at the abattoir. Ante-mortem inspection was conducted by applying a specific range of procedures that consider the behavior and appearance, as well as signs of disease in animals (FAO, 2009). Ante-mortem inspection of cattle took place in pens on the premises and each animal was observed at rest and in motion for the general status. Only animals that were judged to be sufficiently rested were proceeding to slaughter. Each animal selected for the study was further identified by providing a unique identification number that was used for the preceding postmortem examination.
Postmortem examination: After slaughter and before flaying, slaughtered animals were identified by recording the code given at anti-mortem. Animals were visually inspected and their rumen and reticulum were palpated immediately post slaughter. Then, the stomach was gently removed from the abdominal cavity and all the contents were examined carefully for the presence or absence of any foreign material. The location and types of foreign bodies that were found in the stomach were properly recorded. When foreign bodies were found, they were removed, washed, and identified and photographed.

Data analysis

Data was entered into a Microsoft Excel spreadsheet and summarized using descriptive statistics. For analysis, SPSS Microsoft software Version 17.0 was used. Descriptive analysis and Pearson chi square ($\chi^2$) test were employed to assess the existence of association between prevalence of the foreign bodies and different potential risk factors considered. P-values less than 0.05 was considered significant.

Results

Overall prevalence of foreign body in rumen and reticulum of cattle

From the total of 384 cattle examined for the presence of indigestible foreign bodies in their rumen and reticulum, 67 (17.5%) were found to be positive. From the 17.5% positive cases for rumen and reticulum foreign bodies, 40 (59.7%) had foreign bodies in the rumen while 16 (23.8%) in the reticulum and 11 (16.4%) were positive for foreign bodies in both rumen and reticulum. The types of foreign bodies detected during this study were clothes, leather, rope, wire, plastic, calcified bodies, and the combination of both plastic and clothes and plastic and rope. These all comprise cloth 15 (22.38%), leather 6 (8.9%), rope 7 (10.44%), wire 3 (4.47%), calcified body 3 (4.47%), plastic 21 (31.34%), plastic and cloth 8 (11.94%) and plastic and rope 4 (5.97%). Representative images of foreign bodies recovered from rumen and reticulum of cattle are shown (Figure 2).
Jebessa et al.,

Figure 2. Representative image of indigestible foreign bodies from cattle slaughtered at Nekemte Municipal Abattoir A) Plastic bag recovered from rumen, B) A ball mass of leather, C) A rope and interwoven plastic bags.

Prevalence of foreign body in relation to age

Animals in this study were categorized into three age groups as (≤ 5 years), (5-10 years) and (≥10 years) consisting of 54, 185 and 145 number of animals respectively. Eleven (20.4%), 22(11.9%) and 34(23.5%) animals were positive for the presence of foreign bodies in rumen and reticulum in animals with age group of ≤ 5 years, 5-10 years, and ≥10 years, respectively (Table 1). The prevalence of foreign body was significantly high in animals in the older age group compared to the other two groups (p < 0.05).

Table 1. Age distribution of rumen foreign bodies in cattle slaughtered at the Nekemte municipality abattoir

<table>
<thead>
<tr>
<th>Age group</th>
<th>Number examined</th>
<th>Positive for foreign body</th>
<th>Prevalence (%)</th>
<th>95%CI</th>
<th>χ2</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤5 years</td>
<td>54</td>
<td>11</td>
<td>20.4</td>
<td>10.6-33.5</td>
<td>7.91</td>
<td>0.019</td>
</tr>
<tr>
<td>5-10 years</td>
<td>185</td>
<td>22</td>
<td>11.9</td>
<td>7.6-17.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥10 years</td>
<td>145</td>
<td>34</td>
<td>23.5</td>
<td>16.8-31.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>384</td>
<td>67</td>
<td>17.5</td>
<td>13.7-21.6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Weight of foreign bodies in relation to body condition score

In this study, the result was divided in to two categories as those ≤ 300 grams and > 300 grams for simplicity. Among the total of 384 animals examined 23
(6%) animals contain foreign body weighing ≤ 300 gm while 44 (11.5%) animals contain foreign body weighing > 300 gm. Based on the body condition score 8(8.3%) and 21(21.8%) poor body condition animals had foreign bodies weighing ≤ 300 gm and > 300 gm, respectively; while 14(6.8%) and 17(8.3%) animals with medium body condition had foreign bodies weighing ≤ 300 and > 300 gm respectively, and 1(1%) and 6(7%) animals with good body condition had foreign bodies weighting ≤ 300 gm and > 300 gm respectively (Table 2). Those animals in poor body condition had higher prevalence of foreign body weighing > 300 gm followed by those with medium and good body condition score.

Table 2. Body condition score and weight of foreign body distributions in cattle slaughtered at the Nekemte municipality abattoir

<table>
<thead>
<tr>
<th>Body condition score</th>
<th>Animals examined</th>
<th>Animals with foreign body</th>
<th>Weight of foreign body</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>≤ 300gm</td>
<td>&gt; 300gm</td>
</tr>
<tr>
<td>Poor</td>
<td>96</td>
<td>29</td>
<td>8 (8.3%)</td>
</tr>
<tr>
<td>Medium</td>
<td>203</td>
<td>31</td>
<td>14(6.9%)</td>
</tr>
<tr>
<td>Good</td>
<td>85</td>
<td>7</td>
<td>1(1.2%)</td>
</tr>
<tr>
<td>Total</td>
<td>384</td>
<td>67</td>
<td>23(6%)</td>
</tr>
</tbody>
</table>

Prevalence of foreign body in relation to the origin of the animals

Animals slaughtered at Nekemte municipal abattoir during this study came from six different districts (Amuma, Arjo-Gudatu, Bandira, Diga, Uke and Wayutuka). The highest prevalence was observed in cattle brought from Arjo-Gudatu whereas; there was no detection of foreign body from cattle originated from Amuma. In the present study significant association (p <0.05) with the prevalence of the foreign bodies among locality was observed (Table 3).

Prevalence of foreign bodies in relation to sex and body condition of cattle

Among the total animals examined for the presence of foreign bodies 46, (17.6%) male, and 21(25.4%) female animals were positive for foreign body in their rumen and reticulum. This study showed that there was a significant difference in prevalence of foreign body between sex (p =0.049). From the total of 96, 203 and 85 poor, medium and good scoring animals 29(30.2%), 31(15.2%) and 7(8.2%) were, respectively positive for foreign body in their rumen and re-
ticulum. Statistically there was significant difference among the three groups of animals \((p<0.05)\) (Table 4).

Table 3. Prevalence and frequency of foreign body distribution of animal originated from different localities and slaughtered at Nekemte municipality abattoir

<table>
<thead>
<tr>
<th>Origin</th>
<th>Animals examined</th>
<th>positive foreign body</th>
<th>Prevalence (%)</th>
<th>95% CI</th>
<th>(\chi^2)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amuma</td>
<td>9</td>
<td>0</td>
<td>0</td>
<td>0-33.6</td>
<td>13.1</td>
<td>0.028</td>
</tr>
<tr>
<td>Arjogudatu</td>
<td>78</td>
<td>20</td>
<td>25.6</td>
<td>16.4-36.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bandira</td>
<td>124</td>
<td>22</td>
<td>17.7</td>
<td>11.5-25.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diga</td>
<td>71</td>
<td>11</td>
<td>15.6</td>
<td>7.9-26.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uke</td>
<td>81</td>
<td>11</td>
<td>11.6</td>
<td>6.9-23.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wayutuka</td>
<td>21</td>
<td>3</td>
<td>14.3</td>
<td>3.0-36.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>384</td>
<td>67</td>
<td>17.5</td>
<td>13.7-21.6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4. Prevalence and frequency of rumen and reticulum foreign bodies in relation to sex and body condition score in cattle slaughtered in Nekemte abattoir

<table>
<thead>
<tr>
<th>Factors</th>
<th>Level of factors</th>
<th>Animals examined</th>
<th>Animals with foreign body</th>
<th>Prevalence (%)</th>
<th>95% CI</th>
<th>(\chi^2)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body condition</td>
<td>Poor</td>
<td>96</td>
<td>29</td>
<td>30.2</td>
<td>21.3-40.4</td>
<td>16.5</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>203</td>
<td>31</td>
<td>15.3</td>
<td>10.6-21.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Good</td>
<td>85</td>
<td>7</td>
<td>8.23</td>
<td>3.4-16.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>Male</td>
<td>299</td>
<td>46</td>
<td>15.4</td>
<td>11.5-20.0</td>
<td>3.99</td>
<td>0.049</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>85</td>
<td>21</td>
<td>24.7</td>
<td>16-35.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Discussion

Available literatures indicated that indigestible foreign body in rumen and reticulum is one of the most important diseases of cattle requiring surgical intervention in the third world countries. This study revealed an overall prevalence of 17.5\% of rumen and reticulum indigestible foreign body in cattle slaughtered at Nekemte municipal abattoir. The result obtained from this preliminary work is in agreement with the reports of previous researchers (Bassa
and Tesfaye, 2017; Ushula and Nana, 2017). Likewise, Mushonga et al. (2015) obtained similar results from the rumen and reticulum of cattle in Rwanda. On the other hand, the result obtained from this study is higher than the report made by Tesfaye and Chanie (2012) from Jimma municipal abattoir and by Berrie et al. (2015) from Gondar Elfora abattoir. On the contrary, reports made by Negash et al. (2015) from Haramaya Municipal Abattoirs and Shiferaw and et al. (2014) from the Amhara region showed a prevalence rate of 43.4% and 41.8%, respectively. A higher prevalence rate was also reported by Mekuanint et al. (2017) from Addis Ababa municipal abattoirs Khurshaid et al. (2013) reported a prevalence rate of 59.14% from Pakistan. Variations in the prevalence rate in the different regions seems to be due to the level of environmental pollution by plastic foreign materials as the use of plastic bags for carrying goods is less practiced in some of the localities. Grazing lands are contaminated with indigestible materials mainly by plastic foreign bodies in semi urban and urban areas. Hence those cattle raised in rural areas are less affected than those reared in semi urban and urban areas. Shortage of forage and absence of supplementary feed especially during the long dry season predispose the animals to a negative energy balance that in turn force them to eat unusual materials including plastics, cloth, rope and even metallic objects (Hailat et al., 1996; Tesfaye and Chanie, 2012).

The highest frequency of occurrence of rumen and reticulum foreign bodies were detected in animals greater than 10 years (23.45%) followed by 5-10 years (11.83%) and less than 5 years (20.4%). This finding is in agreement with Hailat et al. (1998) who reported prevalence rate of 59.14% foreign bodies in rumen and reticulum in older cattle. Old dairy cattle are the most commonly affected group (Radostitis et al., 2007). Similarly, highest prevalence (81.25%) of foreign bodies was detected in cattle greater than 10 year age by Khurshaid et al. (2013). This finding was also in agreement with the work of Fromsa and Mohammed (2011) who recovered plastics, leather, clothes and ropes at higher prevalence from the rumen and reticulum of old sheep and goats. Mekuanint et al. (2017) reported that indigestible rumen foreign body detection was higher in adult ruminants (46.7%) than young ruminants (12.9%). This might be associated with increase of exposure through life and many were found to accumulate and lead animals to be positive. The prevalence of foreign body was seen in female animals than male, there were a significant statistical difference ($\chi^2=3.99; p=0.049$) between sex were recorded. Tiruneh and Yesuwork (2010) reported higher degree of occurrence of foreign bodies in female sheep and goats compared to that of male. Similarly, Vanitha et al. (2010) who detected
foreign bodies more in female cattle than males in study on thirty (30) stray cattle having clinical symptoms suggestive of ruminal impaction. On the other hand, Mekuanint et al (2017) who reported detection of indigestible rumen foreign bodies in both sexes were not similar and there was not statistically significant difference between sexes. This result might associate with increased appetite of female animals due to the nutritional demands during difference in physiological status like during milking, prenatal period and lack of feed.

Regarding body condition score, the highest frequencies of occurrence of rumen and reticulum foreign bodies were detected in poor (30.2%) followed by medium (15.3%) and good (8.23%) body conditioned cattle, and the difference were statistically significant \((p<0.05)\). This result was in agreement with the finding of Tesfaye and Chanie (2012) who reported 72.7 %, 36% and 7.3% in poor, medium and good body condition score, respectively at Gondar Elfora abattoir. This study reveals higher frequency of foreign body occurrence in animals having poor body condition than in good body condition animals and which was also reported in other studies (Fromsa and Mohammed, 2011; Hailat et al., 1996; Tesfaye and Chanie, 2012). Accumulation of indigestible foreign bodies in the rumen interfere with the flow of ingesta and decrease absorption of volatile fatty acid and thus cause reduced weight gain (Igbokwe, 2003; Remi-Adewunmi et al., 2004; Ismael et al., 2007). These effects contributed to poor body condition, and in long period of time, these materials form large tight balls inside the rumen leading to decreased production and loss of weight gain (Tyagi and Singh, 1993).

In this study, foreign bodies in rumen (10.4%) and in reticulum (4.16%) were recorded. This finding was in agreement with the findings of Bassa and Tesfaye (2017) who reported 10.83% in Wolaita Sodo municipal Abattoir. Similarly, Ushula and Nana (2017) also reported (87%) occurred in the rumen and (13%) occurred in reticulum at Hawassa municipal abattoir. This finding also agrees with the work of Tesfaye and Chanie, (2012) who reported the higher number of foreign bodies occurrence in the rumen (79.2%) than in the reticulum (20.8%). Furthermore, Khurshaid et al (2013) also reported that most foreign bodies were encountered in the rumen (58.45%) than the reticulum (19.32%) of Achai cattle at different regions in Pakistan. This is attributed to the larger rumen volume, the cumulative size and material composition of the foreign bodies, and the types of materials, with metals and sharp objects tending to localize preferentially in reticulum (Radostits, 2007). Plastic was
the most commonly encountered (31.5%) foreign material, followed by cloth (22.4%) and the least encountered were calcified materials and wire both comprising (4.5%) each. This finding in general agreed with various reports from different areas of Ethiopia (Fromsa and Mohammed 2011; Tiruneh and Yeseuwork, 2010; Sheferaw et al., 2014; Tesfaye and Chanie, 2012). Igbokwe (2003), Remi-Adewunmi (2004) from Nigeria and Hailat (1996) from Jordan also reported similar findings. This showed that the wide spread use of plastic bags in these areas, improper disposal, and also lack of proper disposal of used and trimmed cloths elsewhere in the environment.

The highest prevalence of foreign body was observed in animals originated from Arjo-Gudatu (25.6%) and the zero prevalence was recorded in those originated from Amuma. According to Ismael et al (2007); Misk et al (1999); Singh and Nigam (1981), the difference in the prevalence rate in locality could be due to difference in the origin of animals and awareness of community about waste management system. Arjo-Gudatu is small town so that the animals have a chance to get access to pieces of metal and plastics around construction sites. Moreover, improper disposal of plastic bags from shops, market places, and by the public could have contributed for the higher occurrence of the problem in those animals originated from Arjo-Gudatu. Industrialization and mechanization of agriculture could be the other factor in the increased occurrence of foreign bodies in animals originated from this area. Lack of extensive free grazing area, forced the animals to look for feed, to go to nearby town, market place and road side that are polluted with those indigestible materials.

While comparing weight of foreign body versus body condition score of animals foreign bodies weighing ≥300 grams were observed higher in poor body condition animals (21.8%) than in medium (8.4%) and good (7.1%) body condition animals. A slight agreement is observed with work conducted in small ruminants in Addis Ababa municipal abattoirs (Tiruneh and Yeseuwork, 2010). This shows poor body condition by itself might be due to the contribution of the higher weighing place occupied by foreign body that is the animal loss weight after it has been exposed or it might be due to the interference of foreign body with the absorption of volatile fatty acid and thus causes reduced weight gain.
Conclusion

This study showed the presence of improper use and disposal of plastics bags and improper disposal of materials made up of plastics and metals posing risk to the health of cattle grazing in the area. Shortage of feed also increases the likelihood of ingestion of foreign bodies. Therefore, as the country progresses in industrialization and mechanization, the responsible body in government has accountabilities for creating awareness on the impact of foreign bodies on the health of animals. There should be environmental bio-remediation mechanism to minimize the risk of foreign body and examination of suspected animals using ultrasonography which may aid in early diagnosis of foreign bodies which are difficult to detect by clinical examination alone. Further study should be conducted to assess the production and economic effects of foreign body accumulation.

Acknowledgements

The authors are thankful to the technicians of Nekemte abattoir who assisted in sample collection during study period. Many thank also goes to Haramaya University, College of Veterinary Medicine for the scientific support throughout the study period.

Conflict of interest

The authors declare that there is no conflict of interest.

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Health and welfare assessment of working donkeys in and around Rama town, Tigray, Ethiopia

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Abstract

A cross-sectional study was conducted from November 2016 to April 2017 with the objectives to assess the major health problems and associated factors compromising welfare and health of working donkeys in and around Rama Town, Mereb Lake District, Central zone of Tigray Regional state Ethiopia. Both direct observational (animal based) and indirect (owner based) interviews were used to collect data. A total of 384 randomly selected working donkeys were examined and 120 donkey owners were interviewed. From these 27.1%, 45.3%, 9.9%, 22.9%, 17.2% and 41.7% donkeys were suffering from skin coat, wound, musculo-skeletal, parasitic, ocular and behavioral problems, respectively. The occurrence of wound varied significantly \((p<0.05)\) among age categories and higher prevalence was noticed in donkeys more than 15 years of age (85.7%). The body condition score, duration of work and average weight loaded were also having significant \((p<0.05)\) effect on wound prevalence. The findings of indirect assessment revealed that majority (96.7%) of the respondents in the study area had no knowledge and information on donkey welfare. Financial problems and high cost of drugs were the major constraints recorded in this study. The findings of present study indicated that welfare problems are highly prevalent in the working donkeys in the study area.

Keywords: Donkey; Ethiopia; Rama district; Welfare; Wound

Introduction

Ethiopia has about 7.4 million donkeys among which about 4.58 million are used for transportation whereas about 0.83 million and 0.27 million are used for draught and other purposes, respectively (CSA, 2014/15). Although working donkeys are found in all the ecological zones of the country (arid to mountain), the majority are found in the highlands and are primarily used as pack animals. The low level of development of the road transport network and the
rough terrain of the country makes the donkey the most valuable pack animal under the smallholder farming systems of Ethiopia (Gbroweld et al., 1997). Despite the increase in mechanization throughout the world, working donkeys are still well deserving of the name ‘beasts of burden’ in many developing countries. They have an important role to play in transport of people and goods in arid and semi-arid areas where roads are poor or non-existent.

Working donkeys often are involved in more multipurpose activities than horses. They transport goods to and from markets, farms, and shops, travelling long distances. They also pull carts carrying heavy loads. They work from 4 to 12 hours/day, depending on the season and type of work. Unlike horses, working donkeys are not provided with sufficient feed supplements. Feed shortage and disease are the major constraints to productivity and work performance of equines. The welfare issues of donkeys are compromised by resource poor farmers in terms of overloading, overwork and inadequate access to feed or health care facilities. The increasing human population, demands for transport of goods to and from far, remote areas, and construction activities around towns are making donkeys highly demanded animals (Biffia and Woldemeskel, 2006).

Animals are “sentient beings” that experience states such as pain, suffering and satisfaction. Avoidance of management of pain and anguish in animals are commonly considered as ethical necessities in scientific researches and teaching. Hence, animal welfare entails appropriate disease prevention and veterinary care, suitable management, nourishment and gentle handling (Bekele et al., 2013). Despite their use, the husbandry practices of working donkeys are poor. Some hobbling methods cause discomfort and impose ophthalmic problems (Mekuria et al., 2013). Therefore, the objective of the study was health and welfare assessment and associated risk factors of working donkeys in the study area.

**Materials and methods**

**Study area**

The study was conducted from November 2016 to April 2017 in and around Rama town, the administrative centre of Mereb Lake wereda in Tigray region in the semiarid highland of northern Ethiopia. It is one of the operational areas of the International Donkey Sanctuary Trust (IDST). Rama town is situated in Central zone of Tigray, located 258 km north west of Mekelle city 35km
north of the town of Adwa and 7 km from the border with Eritrea. This town occupies a fertile lowland area and located at latitude of 14°25’N and longitude of 38°47’E with an elevation of 1385 meters above sea level. The wereda has annual rain fall of 600-1200mm and average annual temperature of 33.3°C. The climate of the study area is tropical and semi-arid.

Study animals

The study was conducted on indigenous breed of working Abyssinian donkeys which plays major role in the area. Both sex and all age groups of working donkeys were included in the study.

Data collection

Physical assessment

Direct physical examination of working donkeys was done to assess welfare and physical status of the working donkeys. A total of 384 working donkeys were used for direct welfare assessment. The conditions that were assessed include sex, age, body condition score, skin problem, parasite, musculoskeletal problem, eye, dental and mucus membrane abnormality, wound, behaviour of the donkeys and other health problems. The data were collected using data collection format. Body condition score (BCS) of the donkey was estimated and scored in the range of 1 to 5. However, for the purpose of data analysis it was categorized in three major categories, Poor (BCS1-2), Moderate (BCS2-4), Good (BCS>4) (NAWC, 2005). Age of the animal was determined by dentition and it was categorized into five groups; <2.5 years, 2.5-5 years, 6-10 years, 11-15 years and >15 years old (Crane, 1997).

Questionnaire survey

Indirect assessment was conducted by using semi-structured questionnaire to study the welfare of working donkeys. The questionnaire was administered for 120 respondents (donkey owner).

Sample size and sampling method

Sample size required for the study was calculated based on the formula given by Thrusfield (2005). Simple random sampling method was applied. In this study 50% prevalence with 5% desired level of precision and 95% of confidence levels was used to calculate the sample size using the following formula.
N= \[ \frac{1.96^2 \times P_{exp.} \times (1 - P_{exp.})}{d^2} \]

Where:
- N= the required sample size
- 1.96^2 = the value of Z at 95% confidence level
- P_{exp.} = Expected prevalence (=50%)
- D= Desired absolute precision level at 95% confidence interval (=0.05)

Accordingly, a total of 384 donkeys were sampled from the study area.

**Data analysis**

The collected data from direct physical examination and questionnaire survey were entered into a Microsoft Excel Spread sheet and analysed with statistical package for the social science (SPSS) version 20 software. Descriptive and analytic statistics were used and Chi-square test ($\chi^2$) was computed to see the association of risk factors with the target variables of interest. A p-value less than 0.05 was considered significant.

**Results**

From 384 donkeys accessed for direct welfare, 69.3% were male with different age groups. Majority of them were in poor body condition (43%) followed by good (29.7%) and medium (27.3%) body condition. Descriptive statistics for sex, age and body condition score of the sampled donkeys are illustrated in Figure 1.
Results on health condition of working donkeys are shown in Table 1. Overall prevalence of wound was recorded to be 45.3%. Brand/burn sore, back sore and harness sore were the major wound types observed in the working donkeys. Overall prevalence of problems related to skin coat, musculoskeletal, parasitic and eye were 27.1%, 9.9%, 22.9% and 17.2%, respectively. Among skin problems, loss of elasticity (15.9%) was the major problem observed followed by alopecia, habronemiasis and sarcoid. Lameness was recorded in 4.4% of working donkeys. Gastrophilus (16.4%) and ticks (6.5%) were the major parasitic problems observed in this study.
Table 1. Health condition of working donkeys in the study area (N=384).

<table>
<thead>
<tr>
<th>Type</th>
<th>Major health problems</th>
<th>Frequency</th>
<th>Percent (%)</th>
<th>Overall Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin Coat</td>
<td>Alopecia</td>
<td>25</td>
<td>6.5</td>
<td>104 (27.1%)</td>
</tr>
<tr>
<td></td>
<td>Loss of elasticity</td>
<td>61</td>
<td>15.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sarcoïd</td>
<td>8</td>
<td>2.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Habronemiasis</td>
<td>10</td>
<td>2.6</td>
<td></td>
</tr>
<tr>
<td>Type of wound</td>
<td>Back sore</td>
<td>45</td>
<td>11.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Harness sore</td>
<td>33</td>
<td>8.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Brand/burn sore</td>
<td>55</td>
<td>14.3</td>
<td>174 (45.3%)</td>
</tr>
<tr>
<td></td>
<td>Bite sore</td>
<td>22</td>
<td>5.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other injuries</td>
<td>19</td>
<td>4.9</td>
<td></td>
</tr>
<tr>
<td>Musculoskeletal problems</td>
<td>Fracture</td>
<td>0</td>
<td>0.0</td>
<td>38 (9.9%)</td>
</tr>
<tr>
<td></td>
<td>Lameness</td>
<td>17</td>
<td>4.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Swollen joints</td>
<td>12</td>
<td>3.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hooves overgrowth</td>
<td>9</td>
<td>2.4</td>
<td></td>
</tr>
<tr>
<td>Parasitic problems</td>
<td>Ticks</td>
<td>25</td>
<td>6.5</td>
<td>88 (22.9%)</td>
</tr>
<tr>
<td></td>
<td>Lice</td>
<td>0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gastrophilus eggs</td>
<td>63</td>
<td>16.4</td>
<td></td>
</tr>
<tr>
<td>Eye problem</td>
<td>Lacrimation</td>
<td>31</td>
<td>8.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Loss of vision (one eye)</td>
<td>12</td>
<td>3.1</td>
<td>66 (17.2%)</td>
</tr>
<tr>
<td></td>
<td>Inflammation</td>
<td>23</td>
<td>6.0</td>
<td></td>
</tr>
<tr>
<td>Mucous membrane</td>
<td>Pale</td>
<td>26</td>
<td>6.7</td>
<td>39 (10.1%)</td>
</tr>
<tr>
<td></td>
<td>Congested</td>
<td>13</td>
<td>3.4</td>
<td></td>
</tr>
<tr>
<td>Behavioral observation</td>
<td>Hyper-esthetic</td>
<td>27</td>
<td>7.1</td>
<td>160 (41.7%)</td>
</tr>
<tr>
<td></td>
<td>Depressed</td>
<td>133</td>
<td>34.6</td>
<td></td>
</tr>
<tr>
<td>Other diseases</td>
<td>Digestive problem</td>
<td>19</td>
<td>4.9</td>
<td>57 (14.8%)</td>
</tr>
<tr>
<td></td>
<td>Respiratory problem</td>
<td>38</td>
<td>9.9</td>
<td></td>
</tr>
<tr>
<td>Dental condition</td>
<td>Incisor teeth problem</td>
<td>12</td>
<td>3.1</td>
<td>25 (6.5%)</td>
</tr>
<tr>
<td></td>
<td>Cheek teeth problem</td>
<td>13</td>
<td>3.4</td>
<td></td>
</tr>
</tbody>
</table>

Lacrimation (8.1%) and eye inflammation (6.0%) were also recorded. Around 34.6% donkeys were observed to be depressed while 9.9% and 4.9% were observed for respiratory and digestive problems. Overall prevalence of dental problems was observed in 6.5% of donkeys (Table 1).

Prevalence of wound based on work type, sex, BCS, age, duration of work and load are shown in Table 2. Prevalence of wound was higher in donkeys used for draught purpose (49.5%) than those working for pack and other purposes, but no significant difference was observed on overall wound prevalence among
work type ($p>0.05$). Females were more prone to wound prevalence than male but the difference in the prevalence of wound among sex was not significant ($p>0.05$).

Table 2. Prevalence of wound based on work type, sex, BCS, age, duration of work and load (N=384)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number examined</th>
<th>Number affected</th>
<th>Prevalence (%)</th>
<th>$\chi^2$</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work type</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Draught</td>
<td>212</td>
<td>105</td>
<td>49.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pack</td>
<td>151</td>
<td>60</td>
<td>39.7</td>
<td>1.1</td>
<td>0.396</td>
</tr>
<tr>
<td>Other</td>
<td>21</td>
<td>9</td>
<td>42.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>266</td>
<td>116</td>
<td>43.6</td>
<td>1.3</td>
<td>0.371</td>
</tr>
<tr>
<td>Female</td>
<td>118</td>
<td>58</td>
<td>49.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BCS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>165</td>
<td>99</td>
<td>60.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>105</td>
<td>40</td>
<td>38.1</td>
<td>11.5</td>
<td>0.010</td>
</tr>
<tr>
<td>Good</td>
<td>114</td>
<td>35</td>
<td>30.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (year)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under &lt;2.5 years</td>
<td>29</td>
<td>13</td>
<td>44.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5-5 years</td>
<td>76</td>
<td>32</td>
<td>42.1</td>
<td>13.2</td>
<td>0.008</td>
</tr>
<tr>
<td>6-10 years</td>
<td>189</td>
<td>64</td>
<td>33.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11-15 years</td>
<td>69</td>
<td>47</td>
<td>68.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;15 years</td>
<td>21</td>
<td>18</td>
<td>85.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration on work (hour)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 4</td>
<td>131</td>
<td>34</td>
<td>25.9</td>
<td>19.2</td>
<td>0.000</td>
</tr>
<tr>
<td>4-8</td>
<td>174</td>
<td>81</td>
<td>46.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;8</td>
<td>79</td>
<td>59</td>
<td>74.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg. weight loaded (kg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;50</td>
<td>108</td>
<td>39</td>
<td>36.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50-80</td>
<td>169</td>
<td>62</td>
<td>36.7</td>
<td>10.7</td>
<td>0.015</td>
</tr>
<tr>
<td>&gt;80</td>
<td>107</td>
<td>73</td>
<td>68.2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

There was significant difference in the prevalence of wound ($p<0.05$) among different body condition scores. Donkeys with poor condition score were having highest prevalence (60%) of wound followed by those with medium and good body condition. The present study also revealed that the occurrence of wound significantly differs ($p<0.05$) with respect to the age of the donkey. Highest wound prevalence was observed in donkeys with age more than 15 (85.7%) years and 11-15 years (68.1%) than those in the younger age group (Table 2).

The result also showed a significant association ($p<0.05$) between the duration of work and the prevalence of wound. High wound prevalence was observed
in donkeys working for more than 8 hours than those working less. There is also significant association \( p<0.05 \) between prevalence of wound and average weight loaded. The donkeys that carried weight greater than 80 kg had higher prevalence of wound (68.2%) than those carrying less weight (Table 2).

Among the respondents interviewed in the current study, most of them (96.7%) had no knowledge and information about donkey welfare. Vaccination (17.5%) for anthrax and African horse sickness as well as deworming (21.7%) was also practiced by farmers. Sick donkeys were treated mostly in veterinary clinics (35.0%) and by traditional healers (40.8%). Financial problems (44.2%) and unavailability and high price of drug (35.8%) were the major constraints stated by the farmers (Figure 2).

The prevalence of dermatological conditions such as alopecia, loss of elasticity, sarcoid and habronemiasis were common among working donkeys in the study area. The overall prevalence of dermatological conditions was 27.1%, which is higher than the findings of Tesfaye et al (2016) in Mirab Abaya District, Southern Ethiopia (25.8%), Sameeh et al (2014) in Jordan (22.7%), Her-
ago et al. (2015) in Wolaita Soddo Zuria district in southern Ethiopia (12.6%) and Ahmed et al. (2010) in Pakistan (11%). Kumar et al. (2014) reported higher prevalence of skin problem (30.2%) in working donkeys in Mekelle city of Ethiopia. Musculoskeletal, parasitic and eye problem were also observed in the study area which are more or less in line with the findings of Tesfaye et al. (2016), Herago et al. (2015) and Kumar et al. (2014) in the different parts of Ethiopia. Mekuria and Abebe (2010) also reported higher prevalence of ectoparasites in donkeys than horses. Majority of the donkeys showed poor body condition (43.0%) in the current study. Low body condition score was also reported by many researchers in different parts of Ethiopia (Burn et al., 2010; Morka et al., 2014; Kumar et al., 2014). The prevalence of these conditions are associated with owner’s poor knowledge of health care, poor veterinary and extension services, poor feeding and overall management (Biswas et al., 2013; Tesfaye et al., 2016).

The overall prevalence of wound in working donkeys in the present study was 45.3% which was higher than the 40% reported in Central Ethiopia (Pearson et al., 2002). In contrast, a higher prevalence was reported by Curran et al. (2005) in Ethiopia (79.4%), Biffa and Woldemeskel (2006) in Ethiopia (77.5%), Tesfaye et al. (2016) in Mirab Abaya District of southern Ethiopia (59.7%), Herago et al. (2015) in Wolaita Soddo Zuria District of southern Ethiopia (58.6%) and Burn et al. (2007) in Jordan (59%). Harness sore, back sore, brand or burn sore and bite sore were the major sore identified in the current study. The occurrence of these types of wounds in donkeys was also reported in many studies (Pritchard et al., 2005; Kumar et al., 2014). The causes of these wounds are basically related with animal welfare problems like improper harnessing, overloading and overworking of the donkeys (Kumar et al., 2014). Morgan (2008) reported different causes of wound in rural and urban areas. In rural areas, the cause of wound are primarily due to hyena or donkey bites whereas in urban areas it was due to road traffic accidents. Ill-fitting and improperly made tail straps with sharp edge causes lesions on the underneath of the base of tail of working donkeys. Poorly designed and ill fitted harnesses reduce the working efficiency due to discomfort and animals get fatigue (Pearson et al., 2003). It also increases the risk of injuries at the withers, back region and underneath the base of the tail due to friction (Kumar et al., 2014). Painful harness lesion may lead to secondary infections which will reduce the work capacity and longevity of the donkey (Smith, 2014). Branding or burn lesions is caused either by the owner burn-marking the animal or by traditional medical treatments (Burn et al., 2010).
Behavioral problems like hyperesthesia and depression in working donkeys was also reported by many researchers over different parts of the world (Burn et al., 2010; Morka et al., 2014; Kumar et al., 2014). Morka et al (2014) reported 23.1% in and Around Nekemte Town, while Pritchard et al (2005) reported 11.5% of the donkeys were depressed in their studies. Beating donkeys is one of the major causes of behavioral problem. Beating a donkey does not only cause wounds and physical pain but it also induces fear and severe stress to the animal (Rushen et al., 1999; Swann, 2006).

The present study shows that the prevalence of wound in working donkeys were non-significantly related with the type of work and sex which is in line with the findings of Tesfaye et al (2016). In contrary, Herago et al (2015) reported donkeys used for draught purpose had a significantly higher prevalence of wound than those used for pack and other purposes. Rugged landscape, uneven roads, overload, overwork and improper harness are the most plausible explanation for the variation in findings.

Donkeys with poor body condition were found to develop wound than those having good body condition ($p<0.05$) in the current study which is in agreement with the findings of Herago et al.(2015) in Wolaita Soddo Zuria District of southern Ethiopia; Kumar et al (2014) in Mekelle City of Ethiopia; Mekuria et al (2013) in Hawassa town of Ethiopia and Pearson et al (2002) in central Ethiopia. Poor body condition score is an indicator of less body fat. Thin donkeys have less natural padding that protects them from friction, pressure and lesion caused by harnessing, and below score 3 in BCS is correlated with lesions of skin (Pritchard et al., 2005). Animals with poor body condition are more prone to dehydration and decrease the elasticity of the skin and the prominence of bones leading to easy skin injury (Kumar et al., 2014).

The present finding revealed that age had significant effect ($p<0.05$) on prevalence of wound. The older donkeys were seen much more affected than the younger ones. Tesfaye et al (2016), Kumar et al (2014) and Biffa and Woldemeskel (2006) also reported similar findings in their studies on working donkeys in different parts of Ethiopia. Generally old animals have more exposure to work and carrying heavy load over a long distance. Also, prolonged and frequent exposure of working animals in working lifetime, less owners’ attention to wound management and the immune defense mechanism of an animal also reduce with age advancement (Kumar et al., 2014).
Duration of work and average weight loaded were also significantly ($p<0.05$) associated with the occurrence of wound in working donkeys. Generally, a donkey should not carry more than one third of its body weight (Pearson et al., 2003). Overloading and overworking are the predisposing factors for the occurrence of wound (Julia, 2016). Biffa and Woldemeskel (2006) have also reported external injuries due to overwork and overload. Sells et al (2010) and Pritchard et al (2005) reported that when donkeys are carrying heavy load for long distance without sufficient rest, it leads to a higher prevalence of wound due to persistent irritation and reduce their body condition score.

Results of questionnaire survey showed that majority of owners were not having knowledge on donkey welfare issues. Vaccination and deworming are practiced mainly by those farmers who are living near urban areas and have access to veterinary services. Majority (40.8%) of sick donkeys were treated by traditional healers. Tesfaye et al (2016) reported that 48.3% of sick donkeys were taken to nearby veterinary clinic, 35.8% provide house medication (Treat with the medicinal plant) and 15.8% do nothing while Kumar et al (2014) reported that 31.6% of the sick donkeys were taken to the nearby veterinary clinics, 10.5% were treated traditionally, 57.9% did not get any help from their owner and forced to work regardless of the disease. Mohammed (1991) reported that low numbers of donkeys in Ethiopia were taken to the clinic compared to other domestic animals annually and when the donkeys are critically sick, often they were given a number of traditional treatments first. There are many constraints reported by the donkey owners in the study area. Among the major constraints; financial shortage, high price or unavailability of drug, disease, lack of veterinary services and nutritional constraints were commonly reported. Generally, the donkey owners are resource poor farmers and they often lack financial means to provide their donkeys with proper care (Pearson and Krecek, 2006). Diseases and lack of veterinary services as constraints for keeping donkeys were also reported by Kumar et al (2014).

Conclusion

Donkeys are important animals providing traction power, transport services at low cost and source of income generation for resource poor farmers in the study area. But the welfare issues were the major problems encountered in working donkeys. Poor body condition, skin abnormality and presence of various types of wound, parasitic and behavioral problems were the major constraints identi-
fied in this study area which shows lack of owner's awareness towards nutrition, veterinary care and welfare practices. Creation of awareness on welfare issues among the donkey owners through extension activities is recommended.

**Conflict of interest**

The authors declare that there is no conflict of interest.

**References**


Monitoring of body weight, body condition and observation of wound on working equines in HuletEjuEnese district, East Gojjam, Amhara National Regional State, Ethiopia

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Abstract

A study was conducted in urban and rural areas of HuletEjuEnese district to describe body weight, body condition, causes and location of wounds on different body parts of donkeys and mules. A total of 150 donkey and mule owners were selected and interviewed on equine wound management, injury occurrence and the fate of wounded equines. Visual observation and measurement was made on body condition and location of injury on 300 equines. Data was analyzed using the descriptive statistics and general linear model. The major causes of external injury of equines were improper harness (63.4%), over working and over loading (58.9%) and multi factorial causes (32.2%). Observed causes of external injuries were not significantly different (p>0.05) between mules and donkeys. The mean body weight of donkeys in age group 5-15 years (107.2 ± 32.6) was significantly higher (p<0.05) than those below 5 (92.7 ± 19.3kg) and above 15 years (93.7 ± 23.5 kg. Donkeys providing cart pulling had lower mean body weight (98.2 ± 27.9 kg) compared to those involved in pack services (107.3 ± 33.5 kg). The body condition of equines did not vary significantly (p>0.05) with age and sex but significant differences (p<0.05) were observed with work type, working hour and feeding condition. In general, in the study district the body condition of donkeys and mules were poor. Therefore, proper management like optimizing working hours and load, proper harness, and health management are crucial for increasing the performance of working equines. Awareness creation on equine welfare and management is required to alleviate discomfort, pain, occurrence of injuries and other related welfare problems of working equines.
Keywords: Body condition; Body weight; External injury; Equine; HuletEjuEnese

Introduction

Ethiopia is believed to have the largest livestock population in Africa (CSA, 2016/17). The varied and extensive agro-ecological zones and the importance of livestock in livelihood strategies make Ethiopia home to large numbers of livestock. Indeed, Ethiopia has the largest livestock inventory in Africa, 59,486,667 cattle, 30,697,942 sheep and 30,200,226 goats, 8,439,220 donkeys, 409,877 mules, 2,158,176 horses and 59,495,026 chickens (CSA, 2016/17). Ethiopia possesses approximately half of Africa’s equine population with 37%, 58%, and 46% of all African donkeys, horses, and mules, respectively (Biffa and Woldemeskel, 2006). In Ethiopia the contribution of equines is extremely diverse. They carry heavy loads, pulling carts and provide a transportation service; consequently, they contribute significantly to the national economy (Gebreab, 1993). Although in many developing countries including Ethiopia, equines are kept mostly for transportation; people in most peri-urban area hire horses, mules and donkeys for commercial purposes such as carting goods and people and for fetching water. However, Mohammed (1991) reported that in Ethiopia the daily hire charge is the same irrespective of the load carried or the distance traveled.

The husbandry practices of working equines are poor. Some methods of hobbling to restrain equines cause discomfort and inflict wounds (Alujia and Lopez, 1991; Mohammed, 1991) and poorly designed harnesses or yokes that may be heavy and ragged have an adverse effects on the animals health and safety. This misuse, mistreatment and lack of veterinary care for equines have contributed enormously to early death, resulting in shortening working life expectancy of 4 to 6 years. However, in countries where animal welfare is in practice, the life expectancy of equine reaches up to 30 years (Svendsen 1981; Fred and Pascal, 2006).

In HuletEjuEnese district equines are kept for different purposes like cart service, pack service, traction and renting out service. But long working hours and difficult conditions are experienced by working donkeys and mules in the district (WAO, 2011, unpublished). Animals are often forced to work for long hours, and when get free; they are left to graze on natural pasture. These would have a negative impact on their welfare and quality of life of equines.
in the district. Therefore, the objectives of this paper were to describe body weight, body condition and the causes and location of wound on different body parts of equines in HuletEjuEnese district.

Materials and methods

Description of the study area

The study was conducted in HuletEjuEnesie district which is found in East Gojjam zone, Amhara National Regional State, Ethiopia. It is located 370 km northwest of Addis Ababa, capital of Ethiopia. The district is geographically located at 10°45'00" -11°10'00" N latitude and 37°45'69" - 38°10'00" E longitude. The district has an altitude range of 1290-4036 m a.s.l. (WAO, 2011, unpublished). The land use pattern of the district is classified into five categories; 66.7% cultivated, 13% grazing, 7.2% bushes and forest land around homestead, 12.96% land not useful (“Kola”) and 0.14% settlement areas (WAO, 2011, unpublished).

Agroecologically, the district is classified as 52%, 18%, 30% mid-land (“Weinadega”), high land (“Dega”) and lowland (“Kola”), respectively. The mean annual rainfall is 1100 mm and the minimum and maximum rainfall ranging from 997 mm to 1203 mm. The rain fall is bimodal with major rain being in “Kiremt” (June-September) and short rain in April and May (“Belge”). The mean annual temperature is 18.5°C and the range is from mean minimum of 10°C to mean maximum 27°C (WAO, 2011).

The livestock production is one of the major economic bases of the area. The total livestock population in the district is estimated to be 727,157 heads in which 88,112 (12.12%) cattle, 488,649 (67.2%) sheep, 19,579 (2.7%) goats, 17,183 (2.36%) equines and 113,634 (15.62%) poultry. The number of livestock per household is about 3.85, 21.37, 0.86, 0.75 and 4.97 heads for cattle, sheep, goat, equines and poultry, respectively (WAO, 2011, unpublished).

Data collection

Multi-stage sampling techniques were employed where the first stage was district. The district was selected purposively based on equine population, potential cart service, and access of the road in the rural Kebeles of the district. The district was stratified into urban and rural kebeles based on infrastructure, management system and work type of equines. Accordingly, three rural ad-
ministrations and two urban kebeles were randomly selected from a total of 40 rural and 6 urban kebeles based on the proportion of equine abundance.

Thirty households were purposively selected and interviewed based on equine possession (one who has at least one donkey and one mule were selected) from each selected rural administrative and urban kebeles (a total of 150 interviews).

A total of 300 equines (150 mules and 150 donkeys) were used for data collection. One hundred twenty and 180 equines were selected from urban and rural kebeles respectively. Each equine owner having at least one donkey and one mule was selected purposively for the purpose of comparing the two species with work types, feeding conditions and preference of owners. Body weight measurements, body condition scoring and observation of wound were recorded. Data on body weight, body condition and observation of wound on different body parts were collected from 150 mules and 150 donkeys. For households with more than one mule and one donkey, the animals were selected randomly. Body condition score was assessed based on five scales (0-5) based on the criteria described by Carroll and Huntington (1988).

For body weight measurement, girth meter was used for measuring girth and length of equines. But, since the girth meter was not developed for equines reading the body weight from girth meter was not possible; therefore, regression equation for the mule was established as; \( 33 + 2.8G + 1.36L \); where \( G \) is girth and \( L \) is length (Kay, 2007). Whereas for the donkey regression equation was established as; \( G^{2.12} \times L^{0.688/3801} \) where \( G \) is girth and \( L \) is length (Pearson et al., 2000).

**Statistical analysis**

Depending on the type of information collected, different analysis methods were applied. The collected data were organized, summarized and analyzed using Statistical Package for Social Sciences version 16 (SPSS 16, 1996). Descriptive statistics and percentage were used to present the data. Chi-square (\( \chi^2 \)) test was used to determine differences among categorical variables, for example, the fate of wounded equines, body condition scoring of animals and the major causes of external injury of equines. General Linear Model (GLM) procedures were used to analyze effect of explanatory variables on body weight of equines. For working donkeys and mules, the working hours, work type and
The following model was fitted to analyze body weight of equines

\[ Y_{ijklmn} = \mu + W_i + F_j + T_k + S_l + A_m + \varepsilon_{ijklmn} \]

Where;

- \( Y_{ijklmn} \) = body weight on the \( n^{th} \) working equines of the \( i^{th} \) work type and the \( j^{th} \) feed type in the \( k^{th} \) working hours, \( l^{th} \) sex type and \( m^{th} \) age group.
- \( \mu \) = the overall mean common to all animals in the study
- \( W_i \) = fixed effects of the \( i^{th} \) work type (1=pulling cart, 2=riding, 3=pack service, 4=traction, 5=renting out)
- \( F_j \) = fixed effects of the \( j^{th} \) feed type (1=supplemented or 2=not supplemented)
- \( T_k \) = fixed effects of the \( k^{th} \) working hours (1= less than 6 hrs, 2=6-9 hrs, 3= >9 hrs)
- \( S_l \) = fixed effects of the \( l^{th} \) sex type (1= female and 2= male)
- \( A_m \) = fixed effects of the \( m^{th} \) age group (1= less than 5 years, 2= 5-15 years and 3= greater than 15 years)
- \( \varepsilon_{ijklmn} \) = is the random error

**Results**

**Major causes of external injury of equines**

The study demonstrated that the major causes for the occurrence of external injuries of mules and donkeys in the study area were 66.7%, 53.3% and 33.3% improper harness, over loading and over working and multi factorial causes, respectively (Table 1). Improper harnesses were found to cause more external injury of mules \((p<0.05)\) than donkeys. Over working and over loading factors for the cause of external injury were more observed in donkeys\((p<0.05)\) than mules. Unknown causes for the occurrences of external injury were significantly higher in mules \((p<0.01)\) than donkeys.
Table 1. Causes for the occurrence of external injuries of equines in the study district

<table>
<thead>
<tr>
<th>Causes</th>
<th>Donkey N=150</th>
<th>Mule N=150</th>
<th>Total N=300</th>
<th>Chi square</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improper harness</td>
<td>91 (60.7)</td>
<td>109 (72.7)</td>
<td>200 (66.7)</td>
<td>4.9</td>
<td>*</td>
</tr>
<tr>
<td>Over loading and over working</td>
<td>91 (60.7)</td>
<td>69 (46.0)</td>
<td>160 (53.3)</td>
<td>7.8</td>
<td>*</td>
</tr>
<tr>
<td>Biting</td>
<td>11 (7.3)</td>
<td>8 (5.3)</td>
<td>19 (6.3)</td>
<td>0.5</td>
<td>ns</td>
</tr>
<tr>
<td>Infectious disease</td>
<td>30 (20.0)</td>
<td>29 (19.3)</td>
<td>59 (19.7)</td>
<td>0.02</td>
<td>ns</td>
</tr>
<tr>
<td>Nail piercing</td>
<td>5 (3.33)</td>
<td>9 (6.0)</td>
<td>14 (4.7)</td>
<td>1.2</td>
<td>ns</td>
</tr>
<tr>
<td>Cauterization</td>
<td>9 (6.0)</td>
<td>8 (5.3)</td>
<td>17 (5.7)</td>
<td>0.06</td>
<td>ns</td>
</tr>
<tr>
<td>Unknown</td>
<td>22 (14.7)</td>
<td>48 (32.0)</td>
<td>70 (23.3)</td>
<td>12.6</td>
<td>**</td>
</tr>
<tr>
<td>Multi factorial causes</td>
<td>52 (34.7)</td>
<td>49 (32.7)</td>
<td>101 (33.7)</td>
<td>0.13</td>
<td>ns</td>
</tr>
</tbody>
</table>

*p< 0.05; **p< 0.01 value within the row indicates significant and highly significant on the major causes for the occurrences of external injury, respectively; ns=non significant

Location of external injury

Table 2 presents the distribution of external injuries on various body parts of working equines in urban and rural areas. The result showed that donkeys in urban Kebeles had more severe injury in part of shoulder (58.3%) than other body parts. In rural areas the major locations of wound in donkeys were on the back (52.2%). Apparently, mules in urban Kebeles were found more severely injured in part of withers (50.0%) than other body parts.
Table 2. Distribution of external injuries on various body parts of working equines

<table>
<thead>
<tr>
<th>Body parts</th>
<th>Urban N=120</th>
<th>Rural N=180</th>
<th>Total N=300</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Donkey N (%)</td>
<td>Mule N (%)</td>
<td>Total N (%)</td>
</tr>
<tr>
<td>Withers</td>
<td>19 (31.7)</td>
<td>30 (50.0)</td>
<td>49 (40.85)</td>
</tr>
<tr>
<td>Flank</td>
<td>4 (6.7)</td>
<td>1 (1.7)</td>
<td>5 (4.2)</td>
</tr>
<tr>
<td>Back</td>
<td>15 (25.0)</td>
<td>8 (13.3)</td>
<td>23 (19.15)</td>
</tr>
<tr>
<td>Shoulder</td>
<td>35 (58.3)</td>
<td>28 (46.7)</td>
<td>63 (52.2)</td>
</tr>
<tr>
<td>Thigh</td>
<td>11 (18.3)</td>
<td>6 (10.0)</td>
<td>17 (14.15)</td>
</tr>
<tr>
<td>Under tail</td>
<td>7 (11.1)</td>
<td>5 (8.3)</td>
<td>12 (9.7)</td>
</tr>
<tr>
<td>Front leg</td>
<td>2 (3.3)</td>
<td>3 (5.0)</td>
<td>5 (4.15)</td>
</tr>
<tr>
<td>Abdomen</td>
<td>5 (8.3)</td>
<td>8 (13.3)</td>
<td>13 (10.8)</td>
</tr>
<tr>
<td>Hind leg</td>
<td>-</td>
<td>4 (6.7)</td>
<td>4 (3.35)</td>
</tr>
<tr>
<td>Wither and head</td>
<td>4 (6.7)</td>
<td>5 (8.3)</td>
<td>9 (7.5)</td>
</tr>
<tr>
<td>Thigh and front leg</td>
<td>9 (15.0)</td>
<td>5 (8.3)</td>
<td>14 (11.65)</td>
</tr>
<tr>
<td>Wither and thigh</td>
<td>5 (8.3)</td>
<td>9 (15.0)</td>
<td>14 (11.65)</td>
</tr>
<tr>
<td>Others</td>
<td>13 (21.7)</td>
<td>10 (16.7)</td>
<td>23 (19.2)</td>
</tr>
</tbody>
</table>

Management of external injury of equines

There was significant difference ($p<0.05$) between urban and rural areas in the treatment of wounded equines in veterinary health center that most owners in the urban areas took their animals to health clinics. The last choice for treating wounded equines was doing nothing (23.89%) which was significantly higher ($p<0.01$) in rural than urban area (Table 3).
Table 3. Management of wounded equines in HuletEjuEnese district

<table>
<thead>
<tr>
<th>Management of external injury</th>
<th>Urban N=120</th>
<th>Rural N=180</th>
<th>Total</th>
<th>χ² value</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Take to nearby health center</td>
<td>38 (63.33)</td>
<td>42 (46.67)</td>
<td>80 (55.0)</td>
<td>4.02</td>
<td>*</td>
</tr>
<tr>
<td>Medication purchased from local market</td>
<td>16 (26.67)</td>
<td>28 (31.11)</td>
<td>44 (29.0)</td>
<td>0.34</td>
<td>ns</td>
</tr>
<tr>
<td>Take to local healer</td>
<td>8 (13.33)</td>
<td>21 (23.33)</td>
<td>29 (18.33)</td>
<td>2.31</td>
<td>ns</td>
</tr>
<tr>
<td>Treat with medicinal plants</td>
<td>14 (23.33)</td>
<td>25 (27.78)</td>
<td>39 (25.56)</td>
<td>0.37</td>
<td>ns</td>
</tr>
<tr>
<td>Locally available traditional drug</td>
<td>11 (18.33)</td>
<td>36 (40.0)</td>
<td>47 (29.17)</td>
<td>7.86</td>
<td>**</td>
</tr>
<tr>
<td>Do nothing</td>
<td>8 (13.33)</td>
<td>31 (34.44)</td>
<td>39 (23.89)</td>
<td>8.34</td>
<td>**</td>
</tr>
</tbody>
</table>

*p<0.05; **p<0.01 value within the row indicates significant and highly significant on the management of external injury, respectively; ns=non significant

**Body Condition scoring of equines**

Tables 4 and 5 present the body condition score of donkeys and mules. Equines under different working hours, work type and feeding condition had different body condition scoring (p<0.05) while age group and sex did not have significant (p>0.05) effects on body condition scoring for both urban and rural areas. In thin body condition category the proportion of donkeys which belonged to traction and cart services were higher than other work type. In good body condition category the proportion of donkeys which were rented out and pack work type were higher. The result showed that in thin body condition division, the proportion of donkeys which belonged to working hours in the range of >9 working hrs were higher than other class of working hours. In good body condition category the proportion of donkeys which belonged to the range of less than 6 working hrs and 6-9 hrs were higher than other class of working hours. Supplementary feeding practices had significant different (p< 0.05) on body condition of equines.
<table>
<thead>
<tr>
<th>Factors</th>
<th>Rural</th>
<th>Urban</th>
<th>Body condition</th>
<th>Body condition</th>
<th>Chi-square</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thin</td>
<td>Medium</td>
<td>Good</td>
<td>chi</td>
<td>p-value</td>
<td>Thin</td>
</tr>
<tr>
<td>Age group</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;5 years</td>
<td>16.0</td>
<td>68.0</td>
<td>16.0</td>
<td>2.2</td>
<td>ns</td>
<td>30.0</td>
</tr>
<tr>
<td>5-15 years</td>
<td>10.1</td>
<td>65.6</td>
<td>26.3</td>
<td></td>
<td></td>
<td>22.64</td>
</tr>
<tr>
<td>&gt;15 years</td>
<td>7.7</td>
<td>61.5</td>
<td>30.8</td>
<td></td>
<td></td>
<td>12.5</td>
</tr>
<tr>
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<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Female</td>
<td>8.96</td>
<td>64.2</td>
<td>26.9</td>
<td></td>
<td></td>
<td>18.99</td>
</tr>
<tr>
<td>Male</td>
<td>12.1</td>
<td>63.9</td>
<td>24.1</td>
<td></td>
<td></td>
<td>25.35</td>
</tr>
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<td>Working hours</td>
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<td>24.4</td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>6-9 hrs</td>
<td>3.3</td>
<td>50.0</td>
<td>46.7</td>
<td></td>
<td></td>
<td>20.8</td>
</tr>
<tr>
<td>&gt;9 hrs</td>
<td>17.8</td>
<td>56.5</td>
<td>26.1</td>
<td></td>
<td></td>
<td>34.3</td>
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<td>Work types</td>
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<td>14.06</td>
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<tr>
<td>Traction</td>
<td>33.3</td>
<td>66.7</td>
<td>-</td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Pack</td>
<td>3.33</td>
<td>70.0</td>
<td>26.7</td>
<td></td>
<td></td>
<td>15.9</td>
</tr>
<tr>
<td>Ridden</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td>17.8</td>
</tr>
<tr>
<td>Cart service</td>
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<td>57.6</td>
<td>22.7</td>
<td></td>
<td></td>
<td>27.7</td>
</tr>
<tr>
<td>Renting out</td>
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<td>33.3</td>
<td></td>
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<td>Feeding practices</td>
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<td>67.03</td>
<td>27.5</td>
<td></td>
<td></td>
<td>16.4</td>
</tr>
<tr>
<td>not supp</td>
<td>18.6</td>
<td>59.3</td>
<td>22.03</td>
<td></td>
<td></td>
<td>37.5</td>
</tr>
</tbody>
</table>

*p < 0.05 value within the column indicates significant difference of body condition on different fixed factors; ns=non significant
Like that of donkeys, body condition of mules was affected by working hours, work type and supplementation. But age group and sex of mule did not affect their body condition score. In thin body condition category, the proportion of mules which belonged to traction (33.3%) was higher than other work type. In good body condition groups, the proportion of mules which were engaged in renting out and pack work type were higher. The study showed that in thin body condition category, 34.29% of mules which works for over 9 hrs were higher than other class of working hours. In good body condition group 78.58% of mules working less than 6 working hrs per day were higher than other class of working hours. Supplementary feeding practice had significant effect ($p<0.05$) on body condition of mules.

**Body weight measurement of equines**

The means and the standard deviations of body weight of donkeys and mules are shown in Table 6. Age of animals showed significant difference on the body weight of donkeys and mules in both urban and rural areas. The body weight of donkey on age group in 5-15 years (107.2±32.6) was found significantly greater ($p<0.05$) than age groups <5 years (92.7±19.3kg) and greater than 15 years (93.7±23.5 kg) in rural area.

The body weight of donkeys involved in cart service (98.19±27.89 kg) was significantly different ($p<0.05$) as compared with donkeys involved in pack service (107.3±33.5 kg). The sex of donkey had significant difference on body weight ($p<0.05$) where female donkeys (96±23.4 kg) were having lower body weight than males (107.2±33.7 kg).
### Table 5. Body condition scoring of mules in HuletEjuEnese district

<table>
<thead>
<tr>
<th>Factors</th>
<th>Rural</th>
<th></th>
<th>Urban</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thin</td>
<td>Medium</td>
<td>Good</td>
<td>chi</td>
</tr>
<tr>
<td>Age group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;5 years</td>
<td>16.0</td>
<td>68.0</td>
<td>16.0</td>
<td>2.2</td>
</tr>
<tr>
<td>5-15 years</td>
<td>10.10</td>
<td>63.64</td>
<td>26.26</td>
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<tr>
<td>&gt;15 years</td>
<td>7.69</td>
<td>61.54</td>
<td>30.77</td>
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</tr>
<tr>
<td>Sex</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Female</td>
<td>8.96</td>
<td>64.18</td>
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<td>12.05</td>
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<tr>
<td>Working hours</td>
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<td>&lt;6 hrs</td>
<td>-</td>
<td>78.58</td>
<td>24.43</td>
<td>15.62</td>
</tr>
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<td>6-9 hrs</td>
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<td>50.0</td>
<td>46.67</td>
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<tr>
<td>&gt;9 hrs</td>
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<td>56.52</td>
<td>26.09</td>
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<td>Work types</td>
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<tr>
<td>Traction</td>
<td>22.3</td>
<td>77.67</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Pack</td>
<td>3.33</td>
<td>70.0</td>
<td>26.67</td>
<td></td>
</tr>
<tr>
<td>Ridden</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Cart service</td>
<td>19.7</td>
<td>57.58</td>
<td>22.73</td>
<td></td>
</tr>
<tr>
<td>Renting out</td>
<td>-</td>
<td>66.67</td>
<td>33.33</td>
<td></td>
</tr>
<tr>
<td>Feeding practices</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>supplemented</td>
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<td>67.03</td>
<td>27.47</td>
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<tr>
<td>not supp</td>
<td>18.64</td>
<td>59.32</td>
<td>22.03</td>
<td></td>
</tr>
</tbody>
</table>

*p < 0.05 value within the column indicates significant difference of body condition on different fixed factors; ns=non significant
Supplementary feeding of donkeys had significant difference on body weight ($p<0.05$) where supplemented donkeys had higher body weight (104.436±30.08 kg) than not supplemented donkey (98.97±32.10 kg). Donkeys working for $>9$ hrs (92±17.2 kg) had significantly lower body weight ($p<0.05$) than donkeys working in range of less than 6 working hrs (128.1±34.6kg) and 6-9 hrs(123.4±41.7kg), respectively.

The research result showed that the body weight of mules on age group had significant difference ($p<0.05$) in all age range of less than 5 years, 5-15 years and greater than 15 years were 437.4±45.7 kg, 488.3±30.2kg and 466.5±34.6 kg, respectively. Apparently, the work type showed that cart service (467.4±34.2 kg) had significant difference ($p<0.05$) as compared with pack (487.14±39.5kg), riding (486.04±25.5kg), but no significant difference ($p> 0.05$) with traction (435.3±23 kg) and renting out (467.7±38.5kg). The sex of mules had significant difference on body weight ($p<0.05$) where female (467.8±36kg) had lower body weight than males (486.95±34.7 kg). Supplementary feeding of mules is associated with significant difference on body weight ($p< 0.05$) where supplemented (482.9±32.7kg) mules had higher body weight than not supplemented mules (459.5±24kg).

51

### Table 6. Body weight of donkeys and mules in HuletEjuEnese district

<table>
<thead>
<tr>
<th>Factors</th>
<th>Rural</th>
<th>Urban</th>
<th>Rural</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Donkey</td>
<td>Mule</td>
<td>Donkey</td>
<td>Mule</td>
</tr>
<tr>
<td></td>
<td>No.=90</td>
<td>No.=90</td>
<td>No.=60</td>
<td>No.=60</td>
</tr>
<tr>
<td>Mean±S.D</td>
<td>Mean±S.D</td>
<td>Mean±S.D</td>
<td>Mean±S.D</td>
<td>Mean±S.D</td>
</tr>
<tr>
<td>Age group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;5 years</td>
<td>92.7±19.30b</td>
<td>437.4±45.77c</td>
<td>86.9±8.95b</td>
<td>430.78±28.9b</td>
</tr>
<tr>
<td>5-15 years</td>
<td>107.2±32.6c</td>
<td>488.3±30.2a</td>
<td>117.7±36.8a</td>
<td>488.7±32.5a</td>
</tr>
<tr>
<td>&gt;15 years</td>
<td>93.7±23.5b</td>
<td>466.5±34.6a</td>
<td>94.6±15.3b</td>
<td>459.1±25.98a</td>
</tr>
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<td>Work type</td>
<td>*</td>
<td>*</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Pack</td>
<td>107.3±33.5a</td>
<td>487.14±39.5a</td>
<td>111.6±34.2</td>
<td>490.8±42.9</td>
</tr>
<tr>
<td>Ridden</td>
<td>-</td>
<td>486.04±25.5a</td>
<td>-</td>
<td>478.6±21.8</td>
</tr>
<tr>
<td>Traction</td>
<td>106.5±17.2a</td>
<td>435.3±23.00ab</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Cart service</td>
<td>98.2±27.9a</td>
<td>467.38±34.2a</td>
<td>101.9±36.9a</td>
<td>455.1±45.0</td>
</tr>
<tr>
<td>Renting out</td>
<td>100±29.4b</td>
<td>467.73±35.2ab</td>
<td>110.01±37.2</td>
<td>466.3±38.5</td>
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<tr>
<td>Feeding practices</td>
<td>*</td>
<td>*</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Supplemented</td>
<td>104.36±30.08a</td>
<td>482.89±32.69a</td>
<td>107.09±35.12</td>
<td>475.25±35.72</td>
</tr>
<tr>
<td>Not supplemented</td>
<td>98.97±32.10b</td>
<td>459.46±24b</td>
<td>104.97±33.88</td>
<td>469.45±41.13</td>
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<tr>
<td>Working hrs</td>
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<td>*</td>
<td>*</td>
<td>ns</td>
</tr>
<tr>
<td>&lt; 6 hrs/day</td>
<td>128.05±34.60a</td>
<td>501.87±33.15a</td>
<td>120.05±34.60a</td>
<td>493.33±34.87</td>
</tr>
<tr>
<td>6-9 hrs/day</td>
<td>123.35±41.69a</td>
<td>478.05±39.75a</td>
<td>127.35±44.69a</td>
<td>486.99±27.60</td>
</tr>
<tr>
<td>&gt;9 hrs/day</td>
<td>92.00±17.18a</td>
<td>472.54±36.03a</td>
<td>94.00±27.18a</td>
<td>469.28±38.74</td>
</tr>
<tr>
<td>Sex</td>
<td>*</td>
<td>*</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Male</td>
<td>107.17±33.7</td>
<td>486.95±34.7</td>
<td>104.2±33.7</td>
<td>478.95±37.2</td>
</tr>
<tr>
<td>Female</td>
<td>95.98±23.4</td>
<td>467.81±36</td>
<td>99.8±33.3</td>
<td>468.4±36.8</td>
</tr>
</tbody>
</table>

*a,b,c*Means with different letters in the same column are significantly different at the indicated level; *p<0.05; *p<0.01; NS – None significant

### Discussion

The study demonstrated that the major causes of external injuries of mules and donkeys in the study area were improper harness (66.7%), over loading (53.3%), over working (33.3%), and multi factorial causes. Harness as cause of external injury was more significant in mules (*p<0.05*) than donkeys. This might be due to the aggressive behavior of mule leading to improper fitting of harness to their body and work type variation of the two species where mules are used for cart. Over working and over loading factor for the cause of external injury were higher in donkeys (*p<0.05*) than mules. Pearson *et al* (2000)
reported a similar situation in central Ethiopia where over weight and type of load/work contributed to high cases of back sores in donkeys. In agreement with this observation, Fred (2002) also reported that donkeys in Kenya developed extensive sores and wounds due to over working.

The reason for significantly high unknown causes of external injury in mules which might be due to the characteristics of mule were difficult to determine the causes for the occurrence of injury. In agreement with the present study, improper harness and saddle were major causes of injuries in equines in central and northern Ethiopia (Pearson et al., 2000; Bradbury, 2002). Similarly, sores due to harness in Ethiopia are common and are present in the form of saddle sores, fistulous withers and girth sores (McLeod, 1998; ILPH, 1999). Where equine are in poor body condition and lack the layer of subcutaneous fat, there will be a higher prevalence of sores due to ill-fitting or badly made harness (ILPH 1999; Bradbury and Bubear, 2001). In agreement with the present study in Ethiopia 26.9%, 20.5%, 14.9% of external injury of equines caused by improper harness and saddle, over loading and over working, multi factorial, respectively (Alemayehu et al., 2000; Biffa and Woldemeskel, 2006).

More severe shoulder injuries (58.3%) than other body parts of donkeys in urban Kebeles might be harness for cart services have more impact on shoulder than other parts. In rural areas, the major locations of wound of donkeys were on the back (52.2%) as the animals are used for pack service. According to Biffa and Woldemeskel (2006) back/shoulder (22.8%) and wither (20.9%) injuries were common in donkeys. Apparently, mules in urban Kebeles were found more severally injured in part of withers (50.0%) than other body parts whereas, in rural areas the major location of wound of mules were on the back (35.6%). This difference may be due to work type in urban and rural area, respectively. Similarly, Biffa and Woldemeskel (2006) reported that injuries were demonstrated to be commonly distributed on wither and back coinciding with poorly designed and ill-fitted harnesses and saddles.

There was significant difference ($p<0.05$) between urban and rural areas in the treatment of wounded equines in veterinary health center that most owners in the urban areas took their animals to health clinics. The reason may be due to availability of veterinary service and most of the equine owners in urban area were literate. The last choice for treating wounded equines were doing nothing (23.9%) which was highly significant ($p< 0.01$) might be due to, in rural area the majority of households were illiterate and veterinary services were not
accessible. In contrast to the present study Biffa and Woldemeskkel (2006) reported that only 21.4% of the respondents take wounded equines to the nearby veterinary clinic while 8.7% treat with medications purchased from the local market, 27.5% take to a local healer, 2.2% treat with medicinal plants and 40.2% do nothing. Shelima et al. (2007) made similar observation, where 38.3% of wounded equines treated using traditional medicine and 36.2% of wounded equines had no chance to go to veterinary clinic or 17.7% due to financial constraint. Khalil and Omer (2013) reported that care for animals’ wounds was generally similar between farmers, and the majorities of the farmers (60%) buy medicines and treat the animals by themselves; 19% did nothing and wait for the wounds to heal; 12% used local remedies and only 3% took their animals to the veterinary centre.

In thin body condition animals  the proportion of donkeys which belonged to traction and cart service were higher than other work type this might be higher working effort in these work type leading to loss of weight. In good body conditioned animals group, the proportion of donkeys engaged in renting out and pack work type were higher which might be the load on pack service and traction work type were simple. The result showed that in thin body conditioned animals the proportion of donkeys which belonged to working hours in the range of >9 hrs were higher than other class of working hours which might be low exposure for grazing and losing much more energy. In good body conditioned the proportion of donkeys which belonged to the range of less than 6 working hrs and 6-9 hrs were higher than other class of working hours which might be higher exposure for grazing, getting resting time and type of work they perform required simple effort not the case. Supplementary feeding practice had significant effect \( p< 0.05 \) on body condition which might be due to substitution of energy loss by work. Like that of the donkeys, body condition of mules was affected by working hours, work type and supplementation. Age group and sex of animal did not affect body condition score. In thin body condition, the proportion of mules which belonged to traction (33.3%) were higher than other work type which might be because of the higher working effort in these work type which in turn leads to loss of weight. In good body condition groups, the proportion of mules engaged in renting out and pack work type were higher which might be the load on pack service and renting out work type were relatively less.

The study showed that in thin body condition, the proportion (34.29%) of mules which belonged to working hours in the range of >9 hrs were higher than other
class of working hours which might be low exposure for grazing and losing much more energy. In good body condition the proportion (78.58%) of mules which belonged to working hours in the range of less than 6 working hrs per day were higher than other class of working hours which might be higher exposure for grazing, gave rest time and type of work they perform needed simple effort. Supplementary feeding practices had significant effect ($p<0.05$) on body condition which might be due to weight of mules.

The body weight of donkey on age group of 5-15 years was found significantly greater ($p<0.05$) than other age groups <5 years and greater than 15 years in rural area which might be due to the physiological maturity development. Similarly, the mean live weight of donkeys in Ethiopia was found to be 105 kg (Silesi et al., 2002). The body weight of donkeys involved in cart service was significantly low as compared with donkeys involved in pack service, this might be due to the fact that cart service have high work load and frequent working days that may lead to weight loss.

Supplementary feeding of donkeys had significant effect on body weight ($p<0.05$) where supplemented donkeys had higher body weight than not supplemented donkey. The reason why donkeys working over 9 hrs had significantly lower body weight than those in working for less than 6 working hrs and 6-9 hrs might be due to long working hrs which restricts grazing and high weight loses due to high energy utilization.

The possible reason why there is difference in body weight of mules at different age might be due to the physiological maturity. Apparently, the work type showed that cart service had significant difference as compared with pack, riding, but no significant difference ($p>0.05$) with traction and renting out which might be due to the fact that cart service, renting out and traction have high work load that leads to weight loss.

**Conclusion**

For both mules and donkeys, the major causes for the occurrence of injury were improper harnessing, over working and over loading and multi factorial causes. The major causes for the occurrence of external injuries of mule and donkey were not different. Sex, feeding condition, working hours and work type had significant effect on body weight of equines. Work type, feeding con-
dition and working hours had significant effect on body condition of equines; however, sex and age group did not significantly effect body condition. The location of injury on different body parts of equine varied based on species, work type and harness type. The mules and donkeys owners should focus on the selection of harness based for fitting without any injury occurrences rather than on cost of harness. Training and extension advices are required about causes of wound and wound management and harnessing systems to improve the working performance of equines in the study area.

**Acknowledgments**

The authors would like to thank Mertu Le Mariam ATVET College for providing different facilities for the field work. We are also thankful to equine owners in HuletEjuEnese district for providing the required information.

**Conflict of interest**

The authors declare that there is no conflict of interest.

**References**


an International Colloquium held at the Addis Ababa University, Ethiopia, 30th October to 2nd November 2006. pp. 181-188. The Donkey Sanctuary, Sidmouth, Devon, EX10 ONU.


Enteric protozoa of dogs: prevalence, associated risk factors and owners’ awareness in and around Hawassa town, Ethiopia

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Abstract

Dogs are reservoirs of zoonotic pathogens and pose a significant health risk to humans in most parts of the world. A cross sectional study design was used to estimate the prevalence of enteric protozoal parasites in dogs, to assess the associated risk factors and the level of owners’ awareness about zoonotic implications of enteric protozoa parasites in selected subcities of Hawassa town from October 2015 to June 2016. A total of 340 faecal samples were collected and examined for enteric protozoa using flotation techniques. Of these, 171 (50.3%) dogs were infected with one or more genera of enteric protozoa parasites. The parasites identified were Sarcocyst (28.5%), Isospora (20.6%), Cryptosporidium (8.5%), Neospora (8.2%) and Giardia (5.6%). About 34.5% of the examined dogs were infected with two to four enteric protozoa parasites. The overall prevalence of enteric protozoa parasites was significantly higher in younger dogs ($\chi^2 = 20.21, p<0.05$), semi-confined ($\chi^2 = 5.63, p<0.05$) and stray dogs ($\chi^2 = 23.01, p<0.05$). The prevalence of Sarcocyst ($\chi^2 = 14.45, p<0.05$), Isospora ($\chi^2 = 4.38, p<0.05$) and Neospora ($\chi^2 = 4.31, p<0.05$) was significantly higher in stray dogs as compared to owned dogs. Most of respondents and dog owners’ (76.5%), had no awareness on zoonotic enteric protozoa parasites of dogs. But 32.8% and 23.2% the respondents’ children hug and play with dogs, respectively. Most of them (71.7%) feed their dogs with uncooked butcher leftover and/or offals. About 66.2% of them dispose of dogs’ feces with garbage. Therefore, extension works for public education to improve public awareness on parasitic zoonoses, is very helpful to reduce the problem to the possible minimum level. Moreover, a close collaboration between veterinarians and public health professionals is highly helpful.

Keywords: Dogs; Enteric protozoa; Ethiopia; Hawassa; Risk factors; Zoonotic
Introduction

Dogs are becoming an important part of societies throughout the world. They have probably the closest contact with human, and could act as reservoirs or carriers and transmitters of zoonotic diseases (Robertson et al., 2000; Irwin (2002). Schantz (1994) reported that the potential health risk to humans of enteric parasites harbored by dogs remains a major problem in most parts of the world. Although none of zoonotic enteric protozoal diseases are life-threatening to humans, several of them can lead to severe illness and are therefore a public health concern. The risk of severe illness is particularly high for the most vulnerable group of the society, namely children, the elderly, pregnant women and immunocompromised (Irwin, 2002). Most of the enteric protozoa of dogs can be transmitted to the domestic livestock in a various ways of transmission mechanism (Dubey et al., 2007; Taylor et al., 2007)

In humans, cryptosporidiosis and giardiasis are both important emerging and “re-emerging diseases” (Martínez-Moreno et al., 2007). These parasites are considered to be a significant risk to immunocompromised people and are commonly recognized causes of diarrhea in infant day care centers (WHO 1996; Robertson et al., 2000). Significant clinical infection has also been reported in immunocompetent adults (Martins and Guerrant, 1995; Ramirez-Barrios et al., 2004).

*Giardia* is common in dogs and cats and in some occasions it is associated with overt symptoms or clinical disease. More importantly, dogs and cats can carry strains of *Giardia* which are potentially infective to humans (Hopkins et al., 1997). *Giardia* species are a frequent cause of diarrhea in immunocompromised people including children, if left untreated, may cause persistent infection leading to irregular episodes of gastrointestinal illness (Ochoa et al., 2004).

*Cryptosporidium* has been widely detected in dogs and cats (Milstein and Goldsmid, 1995; Sargent et al., 1998) and these animals may represent an important reservoir of infection for humans. The infective oocyst may be transmitted to human directly by the fecal/oral route, or through contamination of water supplies (Robertson et al, 2000). It is a common cause of human diarrhea (Current and Garcia, 1991; Hunter and Nichols, 2002). The number of detected human cases began to rise rapidly alongside the AIDS pandemic (Avery et al., 2007). There is a growing concern about the zoonotic potential of *Neospora*
caninum. However, at present there is no firm evidence that *N. caninum* successfully infect humans. But it is transmitted to cattle and causes abortion (Dubey *et al*., 2007).

Most of the intestinal protozoan infections do little or no harm to dogs, especially in adult dogs, these infections go unnoticed or neglected (ESCCAP, 2011). The importance of zoonotic parasites in dogs is evident in most parts of the world. But there is scarcity of information and there is very rare or no research work on zoonotic protozoa parasites of dogs in Ethiopia. Moreover, there is lack of awareness among dog owners about the common zoonotic parasites that could be carried by their dogs and their mode of transmission. There is an increasing number of companion animals, especially dogs, kept in close interaction with human beings in Hawassa town. But there is no information available on the status of enteric protozoa. Therefore, the objectives of this study was to estimate the prevalence of dog enteric protozoa, to assess the potential risk factors associated with the occurrence of the problem and to assess the level of owners’ awareness about the enteric protozoa parasites of dogs that are zoonotic in Hawassa town.

**Materials and methods**

**Study area**

The study was conducted in and around Hawassa town, capital of Southern Nation Nationalities People Regional State (SNNPRS), from October 2015 to June 2016. It has an area of 162,804 hectares and about 399,461 human populations (CSA, 2013). Hawassa is located between 4°27’ and 8°30’ N latitude, and 34°21’ and 39°1’E longitude at an altitude of 1790 m above sea level. The study area is characterized by short (February to April) and long (July to October) rainy seasons. The mean annual rainfall is 1091 mm, and the mean annual minimum and maximum temperature are 13°C and 27°C, respectively (National Meteorological Agency, 2016).

**Study animals**

The study animals were dogs found in and around Hawassa town. Dogs of different age groups and both sexes were selected by systematic random sampling technique from confined, semi-confined (roaming at night only) management system and stray dogs, free roaming all the time. For simplicity, dogs up to one
year of age were grouped under young age group, while those between 1 and 3 years as adult and those older than 3 years as old. From eight subcities, based on the convenience, willingness and cooperation of owners two sub-cities, Tabor and Meneharia, were included in the study.

**Study design and sampling**

A cross-sectional study design was employed to estimate the prevalence of enteric protozoa parasites, and to assess the level of dog owners awareness of zoonotic enteric protozoa parasites. The study was conducted using active laboratory investigation and questionnaire survey. Age, sex, and management system of dogs were recorded through personal communication with the dogs owners during faecal sample collection. The sample size was determined following the formula described by Thrusfield (2005), and 20% expected prevalence (Pfeiffer, 2002). The study considered 5% absolute precision with 95% confidence interval. As a result, the sample size computed was 246; and however, an additional 94 animals were included and a total of 340 were examined.

During fresh faecal sample collection, the color and consistency of the feces were recorded. Collected faecal samples were placed in clean and sterile universal bottles, labelled and immediately transported to Parasitology laboratory of Hawassa University, School of Veterinary Medicine. Then, it was examined by flotation technique using 33% Zinc sulfate solution with specific gravity of 1.2 (Zajac and Conboy, 2012). Faecal sample was examined on the date of collection, and if not it was preserved with 10% formalin and examined within two days of the collection. The oocysts and/or trophozoites were identified based on their morphological characteristics as described by Hendrix (1998) and MAFF (1977). For detection of Cryptosporidium, the faecal samples were treated with formol-ether concentration and stained by modified Ziehl-Neelsen technique as described by Henriksen and Pohlenz (1981).

**Questionnaire survey**

A pre-tested semi-structured questionnaire was used to collect information about dogs’ housing management and cleaning practices (i.e. use of kennel, cleaning and dog waste disposal), feed and feeding (i.e. major feed source for dog and habit of meat cooking for dog), awareness of dogs’ zoonotic parasites
and children-dog interaction (i.e. whether not approach to dogs, play with dogs, and hug and play with dogs).

Data management and analysis

Data collected were entered into Microsoft Excel spreadsheet, edited and coded. Descriptive statistics was used to summarize the data. Chi-square test and logistic regression analysis were used to assess difference in prevalence between the various risk factors that considered for this study. For the data analysis STATA software, window version 13.1 (StataCorp 4905 Lakeway DriveCollege Station, 2013) was used. The study considered 95% confidence level and 5% desired level of precision.

Results

Overall prevalence of enteric protozoa parasites

Of the total 340 dogs examined 171 (50.3%) of them were found infected by enteric protozoa parasites. Five genera of enteric protozoa parasites were identified namely: Sarcocyst, Isospora, Cryptosporidium, Neospora and Giardia (Table 1).

<table>
<thead>
<tr>
<th>Protozoa genera</th>
<th>No of positive dogs</th>
<th>Prevalence (%)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isospora spp.</td>
<td>70</td>
<td>20.6</td>
<td>16.3–24.9</td>
</tr>
<tr>
<td>Cryptosporidium spp.</td>
<td>29</td>
<td>8.5</td>
<td>5.5–11.5</td>
</tr>
<tr>
<td>Neospora spp.</td>
<td>28</td>
<td>8.2</td>
<td>5.3–11.2</td>
</tr>
<tr>
<td>Sarcocysts spp.</td>
<td>97</td>
<td>28.5</td>
<td>23.7–33.4</td>
</tr>
<tr>
<td>Giardia spp.</td>
<td>19</td>
<td>5.6</td>
<td>3.1–8.0</td>
</tr>
<tr>
<td>Overall</td>
<td>171</td>
<td>50.3</td>
<td>44.9–55.6</td>
</tr>
</tbody>
</table>

From 171 infected dogs about 59 (34.1%) were found to harbor two to four genera of enteric protozoa parasites (Table 2). About half of the examined dogs were found harboring one or more than one types of enteric protozoa. From the total infected dogs fifty nine of them (34.5%) were infected with more than one genus of the identified enteric protozoa.
Table 2. Proportion of dogs infected with single and multiple genera of enteric protozoa (n=171)

<table>
<thead>
<tr>
<th>Number of species</th>
<th>Frequency</th>
<th>Prevalence %</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>One</td>
<td>112</td>
<td>32.9</td>
<td>28.1-38.1</td>
</tr>
<tr>
<td>Two</td>
<td>48</td>
<td>14.1</td>
<td>10.8-18.3</td>
</tr>
<tr>
<td>Three</td>
<td>9</td>
<td>2.6</td>
<td>1.4-5.0</td>
</tr>
<tr>
<td>Four</td>
<td>2</td>
<td>0.6</td>
<td>0.1-2.3</td>
</tr>
</tbody>
</table>

Risk factors for enteric protozoa parasites infection

The analysis results for the risk factors considered in the study are shown in Table 3. The prevalence of enteric protozoa was significantly higher in younger ($\chi^2=20.21, p <0.05$) and free roaming ($\chi^2=23.32, p <0.05$) dogs.

Table 3. Prevalence of enteric protozoa in dogs and the associated risk factors.

<table>
<thead>
<tr>
<th>Risk factors and levels</th>
<th>No. examined</th>
<th>Prevalence (%)</th>
<th>95%CI</th>
<th>$\chi^2$</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>229</td>
<td>54.1</td>
<td>47.7-60.6</td>
<td>2.99</td>
<td>0.084</td>
</tr>
<tr>
<td>Female</td>
<td>111</td>
<td>44.1</td>
<td>34.8-53.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age group</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤1 year</td>
<td>86</td>
<td>66.3</td>
<td>56.2-76.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 to 3 years</td>
<td>118</td>
<td>55.9</td>
<td>46.9-65.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over 3 years</td>
<td>136</td>
<td>36.8</td>
<td>28.6-44.9</td>
<td>20.21</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Village</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tabor</td>
<td>181</td>
<td>52.8</td>
<td>40.7-55.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meneharia</td>
<td>159</td>
<td>48.1</td>
<td>45.0-60.6</td>
<td>0.768</td>
<td>0.381</td>
</tr>
<tr>
<td>Management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free roaming</td>
<td>93</td>
<td>69.9</td>
<td>60.5-79.3</td>
<td>0.768</td>
<td>0.381</td>
</tr>
<tr>
<td>Semi-confined</td>
<td>150</td>
<td>49.3</td>
<td>41.3-57.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strictly confined</td>
<td>97</td>
<td>35</td>
<td>25.5-44.6</td>
<td>23.32</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

The prevalence of the identified enteric protozoa parasites among the management system of dogs is shown below (Table 4). The overall enteric protozoa parasites prevalence significantly varied among the three management systems. It was higher in semi-confined ($\chi^2=5.63, p<0.05$) than strictly-confined.
dogs; and it was significantly higher in stray ($\chi^2 = 8.88, p<0.05$) than in semi-confined dogs.

**Table 4. Linear logistic regression analysis of dogs’ management system and enteric protozoa prevalence.**

<table>
<thead>
<tr>
<th>Protozoa</th>
<th>Management system</th>
<th>No. examined (No. positive)</th>
<th>Prevalence % (95% CI)</th>
<th>OR</th>
<th>Z</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isospora species</td>
<td>Strictly confined</td>
<td>97 (15)</td>
<td>15.5(8.2-22.7)</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Semi-confined</td>
<td>150 (29)</td>
<td>19.3(13.0-25.7)</td>
<td>1.31</td>
<td>0.77</td>
<td>0.438</td>
</tr>
<tr>
<td></td>
<td>- Stray</td>
<td>93 (26)</td>
<td>20.0(18.8-37.2)</td>
<td>2.12</td>
<td>2.07</td>
<td>0.039</td>
</tr>
<tr>
<td></td>
<td>- Stray</td>
<td>93 (8)</td>
<td>5.2(0.7-9.6)</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cryptosporidium spp.</td>
<td>Strictly confined</td>
<td>97 (5)</td>
<td>5.2(0.7-9.6)</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Semi-confined</td>
<td>150 (16)</td>
<td>10.7(5.7-15.6)</td>
<td>2.20</td>
<td>1.49</td>
<td>0.137</td>
</tr>
<tr>
<td></td>
<td>- Stray</td>
<td>93 (8)</td>
<td>8.6(2.9-14.4)</td>
<td>1.73</td>
<td>1.73</td>
<td>0.352</td>
</tr>
<tr>
<td>Sarcocyst species</td>
<td>Strictly confined</td>
<td>97 (18)</td>
<td>18.6(10.8-26.4)</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Semi-confined</td>
<td>150 (38)</td>
<td>25.3(18.3-32.3)</td>
<td>1.49</td>
<td>1.24</td>
<td>0.216</td>
</tr>
<tr>
<td></td>
<td>- Stray</td>
<td>93 (41)</td>
<td>44.1(33.9-54.3)</td>
<td>3.46</td>
<td>3.17</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Neospora species</td>
<td>Strictly confined</td>
<td>97 (5)</td>
<td>5.2(10.8-26.4)</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Semi-confined</td>
<td>150 (10)</td>
<td>6.7(18.3-32.3)</td>
<td>1.31</td>
<td>1.48</td>
<td>0.628</td>
</tr>
<tr>
<td></td>
<td>- Stray</td>
<td>93 (13)</td>
<td>14.0(33.9-54.3)</td>
<td>2.99</td>
<td>2.00</td>
<td>0.046</td>
</tr>
<tr>
<td>Giardia species</td>
<td>Strictly confined</td>
<td>97 (3)</td>
<td>3.1(0.4-6.6)</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Semi-confined</td>
<td>150 (8)</td>
<td>5.3(1.7-9.0)</td>
<td>1.77</td>
<td>0.82</td>
<td>0.410</td>
</tr>
<tr>
<td></td>
<td>- Stray</td>
<td>93 (8)</td>
<td>8.6(2.9-14.4)</td>
<td>2.95</td>
<td>1.56</td>
<td>0.119</td>
</tr>
<tr>
<td>Overall enteroprotocoza</td>
<td>Strictly confined</td>
<td>97 (33)</td>
<td>35.1(24.5-43.5)</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Semi-confined</td>
<td>150 (74)</td>
<td>49.3(41.3-57.4)</td>
<td>1.90</td>
<td>2.26</td>
<td>0.024</td>
</tr>
<tr>
<td></td>
<td>- Stray</td>
<td>93 (64)</td>
<td>69.9(59.3-78.3)</td>
<td>6.18</td>
<td>5.21</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
The prevalence of *Giardia* spp., *Cryptosporidium* spp. and *Isospora* spp. were significantly higher in dogs with diarrheic feces (Table 5).

**Table 5. Enteric protozoa prevalence with respect to fecal consistency of dogs**

<table>
<thead>
<tr>
<th>Feces consistency</th>
<th>No of dogs infected (%)</th>
<th>Giardia spp.</th>
<th>Cryptosporidium spp.</th>
<th>Isospora spp.</th>
<th>Overall protozoa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diarrheic (61)</td>
<td>8(13.1)</td>
<td>14(23.0)</td>
<td>19(31.1)</td>
<td>54(88.5)</td>
<td></td>
</tr>
<tr>
<td>Non-diarrheic(279)</td>
<td>11(3.9)</td>
<td>15(5.4)</td>
<td>51(18.3)</td>
<td>119 (42.7)</td>
<td></td>
</tr>
<tr>
<td>$\chi^2$</td>
<td>7.98</td>
<td>19.81</td>
<td>5.07</td>
<td>42.15</td>
<td></td>
</tr>
<tr>
<td>P-value</td>
<td>0.005</td>
<td>&lt;0.001</td>
<td>0.024</td>
<td>&lt;0.001</td>
<td></td>
</tr>
</tbody>
</table>

**Dog owners’ awareness of zoonotic enteric protozoa**

The questionnaire survey about owners’ awareness of zoonotic enteric protozoa of dogs revealed that 76.5% had no awareness about zoonotic parasites. The result of dog owners’ awareness and dogs management system are shown in Table 6.
Table 6. Summary of dogs management and owner’s awareness about zoonotic protozoa (n=293)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Factors level</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Management</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of kennel</td>
<td>Yes</td>
<td>254</td>
<td>83.83</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>49</td>
<td>16.17</td>
</tr>
<tr>
<td>Kennel cleaning</td>
<td>Yes</td>
<td>246</td>
<td>96.85</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>8</td>
<td>3.15</td>
</tr>
<tr>
<td>Frequency of cleaning</td>
<td>Once per month</td>
<td>40</td>
<td>16.26</td>
</tr>
<tr>
<td></td>
<td>Once per week</td>
<td>37</td>
<td>15.04</td>
</tr>
<tr>
<td></td>
<td>Daily</td>
<td>140</td>
<td>56.91</td>
</tr>
<tr>
<td></td>
<td>Following defecation</td>
<td>29</td>
<td>11.79</td>
</tr>
<tr>
<td>Dogs waste disposal</td>
<td>Outside the compound</td>
<td>49</td>
<td>17.07</td>
</tr>
<tr>
<td></td>
<td>On garden area</td>
<td>9</td>
<td>3.66</td>
</tr>
<tr>
<td></td>
<td>Taken by garbage collectors</td>
<td>163</td>
<td>66.2</td>
</tr>
<tr>
<td></td>
<td>Buried</td>
<td>2</td>
<td>0.81</td>
</tr>
<tr>
<td></td>
<td>Dumped in toilet</td>
<td>30</td>
<td>12.20</td>
</tr>
<tr>
<td><strong>Feed and Feeding</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major food source</td>
<td>Family leftover</td>
<td>112</td>
<td>38.2</td>
</tr>
<tr>
<td></td>
<td>Butcher leftover</td>
<td>150</td>
<td>52.2</td>
</tr>
<tr>
<td></td>
<td>Leftover from hotel</td>
<td>7</td>
<td>2.4</td>
</tr>
<tr>
<td></td>
<td>Left free to scavenge</td>
<td>20</td>
<td>6.8</td>
</tr>
<tr>
<td></td>
<td>Dairy byproduct</td>
<td>4</td>
<td>1.4</td>
</tr>
<tr>
<td>Cooking meat for dog</td>
<td>Yes</td>
<td>83</td>
<td>28.3</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>210</td>
<td>71.7</td>
</tr>
<tr>
<td>Awareness on Zoonoses</td>
<td>Yes</td>
<td>188</td>
<td>64.2</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>105</td>
<td>35.8</td>
</tr>
<tr>
<td>Measure on sick dog</td>
<td>Treat with available drug</td>
<td>62</td>
<td>21.2</td>
</tr>
<tr>
<td></td>
<td>Call a Vet/Visit Vet clinic</td>
<td>191</td>
<td>65.2</td>
</tr>
<tr>
<td></td>
<td>Abandon the dog</td>
<td>8</td>
<td>2.7</td>
</tr>
<tr>
<td></td>
<td>Do nothing</td>
<td>32</td>
<td>10.9</td>
</tr>
<tr>
<td>Children – Dog interaction</td>
<td>Not approach to dog</td>
<td>129</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>Play with dogs</td>
<td>96</td>
<td>32.8</td>
</tr>
<tr>
<td></td>
<td>Hug and play with dogs</td>
<td>68</td>
<td>23.2</td>
</tr>
</tbody>
</table>
Discussion

This study revealed an overall enteric protozoa prevalence of 50.9% in dogs in and around Hawassa, Ethiopia. This is relatively high level of infection; and comparable to the report of Adejinmi and Osayomi (2010). This finding is higher than the reports from various areas: Martinez-Moreno et al (2007), Gingrich et al (2010), Mahmud et al (2014) and Mirzaei (2010) who reported 12.11%, 13.4%, 21.7% and 13.26% from Spain, Galapagos Islands of Ecuador, Bangladesh and Iran, respectively. Such differences in the prevalence of enteric protozoa could be due to variation in geographic location, owners’ awareness and the number of stray dogs’ population in an area. The enteric protozoa identified during this study were Cryptosporidium spp. (8.5%), Giardia spp. (5.6%), Isospora spp. (20.6%), Neospora spp. (8.2%), and Sarcocysts spp. (28.5%). This observation is in agreement with reports from various areas (Khalaf et al., 2015; Ramirez-Barrios et al., 2004; Benito et al., 2003). Dogs harbouring a single enteric protozoa parasite species were more common (32.9%) than those harbouring 2 (14.1%) or multiple species. The finding of infections with more than one enteric protozoa parasites is not surprising, and similar findings have been reported by various authors (Alvarado-Esquivel et al., 2015; Bahrami et al., 2011; Cantó et al., 2011; Adejinmi and Osayomi, 2010; Gingrich et al., 2010; Mukaratirwa and Singh, 2010; Gracenea et al., 2009; Nikolic et al., 2008). The prevalence of enteric protozoa parasites of dogs were significantly higher in free roaming and younger dogs. This finding is in agreement with Symeonidou et al (2017), Awadallah et al (2015), Adejinmi and Osayomi (2010) and Mirzaei (2010) who reported higher prevalence of protozoa parasites in younger dogs.

The overall prevalence of enteric protozoa was significantly higher in stray and semi-confined than in strictly confined dogs. But the prevalence of Isospora spp., Sarcocyst spp. and Neospora spp. were significantly higher in stray dogs than strictly-confined dogs. Sarcocyst spp. is the only enteric protozoa that significantly varied among the management system of dogs in the study area. The possible justification for this higher prevalence in stray dogs could be due to their frequent exposure to infected animals tissues, absence of treatment, and higher access to rodents. Moreover, they had free access to visceral organs, aborted foetus and placenta of intermediate host animals (Sager et al., 2006). These dogs may be at risk of acquiring infections with cyst-forming coccidian like Neospora spp. and Sarcocystis spp. (ESCCAP, 2011).
The overall prevalence of enteric protozoa parasites were significantly higher in diarrheic dogs. Also *Giardia* spp., *Isospora* spp. and *Cryptosporidium* spp. were similarly more prevalent in diarrheic dogs. Dogs infected of by *Giardia* spp. and *Cryptosporidium* spp. may be clinically manifested by pasty to watery diarrhea (ESCCAP, 2011; Taylor et al., 2007).

*Giardia* species detected (5.6%) during this study was lower than the reports from different parts of the world (Alvarado-Esquivel et al., 2015; Mahmud et al., 2014; Li et al., 2012; Bahrami et al., 2011 and Nikolic et al., 2008). This could be due to the intermittent excretion of *Giardia* cysts, which lasts for few days (Villeneuve et al., 2015). So, it is suggested to take samples and examine three times over 3-5 days. Generally, the prevalence of *Giardia* varied from 10% to 100% depending on the sensitivity of the test employed, age of the examined dogs and the level of care and management of dogs (Hahn et al., 1988; Thompson et al., 2008).

During this study we found that 52.2% and 38.2% of the dog owners fed their dogs with families and butcher leftover, respectively. Most of them (71.7%) fed their dogs uncooked butcher leftover and/or offals. This finding is in agreement with the report of Amissah-Reynold et al (2016). Almost one-third of the respondents had no awareness about zoonosis, and their children play with their dogs. According to the information collected from the respondents, the most common means (66.2%) of dogs’ feces disposal was with garbage. This finding is in agreement with Njong et al (2012). This study showed that, the awareness of dog owners on dogs’ management, feeding and zoonosis is poor. Moreover, dog owners’ children having close contact with their dogs and improper feces disposal, taken by garbage collectors, can threaten the public health.

**Conclusion**

The study revealed that about half of the dogs examined (50.3%) were found infected with one or more enteric protozoa parasites. The enteric protozoa parasites detected during this study were *Cryptosporidium*, *Giardia*, *Isospora*, *Sarcocyst* and *Neospora* species. Most of them are zoonotic, posing risk for those people living in the study area. It is particularly important in children playing with dogs. Awareness of dog owners about zoonosis, and as a result feeding of their dogs with uncooked butcher leftover might have contributed a lot for their transmission. Therefore, proper disposal of feces, cooking butcher leftover and keeping children away from dogs should be practiced to prevent
their spread and transmission. In addition, creation of public awareness about zoonotic parasites play key role. Moreover, a close collaboration between veterinarians and public health professionals is highly helpful.

Acknowledgements
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Conflict of interest
The authors declare that there is no conflict of interest.

References


Seroprevalence of *Mycoplasma gallisepticum* in domestic chickens, East Shewa, Ethiopia

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3Prima International Company, Djibouti Regional Quarantine, Djibouti

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Abstract

Cross sectional study was conducted to estimate the sero-prevalence of *Mycoplasma gallisepticum* in domestic chickens and to assess risk factors associated with the disease in commercial and local chickens in East Shewa, Ethiopia. A total of 514 sera were collected (from 187 commercial chickens and 327 local chickens) and tested using an indirect enzyme linked immunosorbant assay (ELISA) to detect antibodies against *M. gallisepticum*. The overall seroprevalence of *M. gallisepticum* was 49.4% (254/514). A statistically significant association \((p<0.05)\) was observed in prevalence between chicken type with prevalence of 64.5% in local and 23% in commercial chickens. Variation in prevalence was observed among the three commercial farms, the highest being in farm-B (46.8%) and the lowest in farm-C (4.25%). Prevalence in local chickens was significantly highest in Lume (72.7%) and lowest in Ada’a (47.5%) \((p<0.05)\). Age was significantly associated with sero-prevalence \((p<0.05)\). Prevalence was 67.3% in layers of (18 to 76 weeks) and 0% in layer chicks of (1 to 8 weeks old). Prevalence was also significantly different between layers (41.7%) and broilers (7.8%) \((p<0.05)\). In commercial chickens, prevalence was significantly higher in females (32.4%) than males (10.1%) \((p<0.05)\). The current study revealed *M. gallisepticum* is prevalent in chicken in East Shewa, Ethiopia.

**Keywords:** Domestic chickens; East Shewa; Ethiopia; *Mycoplasma gallisepticum*; Sero-prevalence
Introduction

Agricultural production dominates the Ethiopian economy and contributes to 45% of gross domestic product (GDP) and provides more than 80% of employment. Ethiopia has the highest livestock populations in Africa and accounts for 17% of cattle, 20% of sheep, 13% of goats and 55% of equines in sub-Saharan Africa. Livestock contributes 16% of GDP. Seventy per cent of cattle, 75% of sheep, 27% of goats and 80% of equines are found in the highlands (Tangka et al., 2002). Of domestic animals in the country, the most numerous are bovines and poultry each estimated 45 million head. This is followed by goats and sheep each at 17 million head, by donkeys (4 million) and by horses and camels (each one million). Poultry are represented exclusively by chickens (FAO, 2008).

In developing countries, poultry production offers an opportunity to feed the fast growing human population and to provide income to the resource poor farmers (Gari, 2004). The sub-sector is concerned with egg and meat production for income generation and home consumption (EARO, 2000; Mohamed, 1998). The main purposes of egg production are hatching (51.8%), sales (22.6%), home consumption (20.2%) and gift (5.4%). The purposes of bird production are sales (26.6%), sacrifice/healing ceremonies (25.0%), replacements (20.3%), home consumption (19.5%) and gift (8.6%) according to Gottard and Soares Magalhaes (2006).

In Ethiopia, live birds and eggs are usually sold by the owner in local markets. Single bird sales or sales of small numbers typify most rural markets, with many sellers competing. During times of festivity, the numbers and the prices of birds in the market rise considerably, because of demand (Dessie and Ogle, 2001). Occasionally, birds are sold to middlemen for transport and sales in the larger towns and cities. The largest proportion of eggs and poultry meat consumed in the country comes from indigenous birds produced by rural growers. Large numbers of these birds are also exported to neighboring countries within trade that is mainly informal. Therefore, the main movement of poultry and poultry products is one of rural producer to urban consumer and from Ethiopia to neighboring countries, which from an Ethiopian biosecurity point of view is profitable, because it is not favorable to the diffusion of poultry diseases all over the country (FAO, 2008).

*Mycoplasma gallisepticum* (MG), the etiologic agent of chronic respiratory disease (CRD), is one of the major pathogens of domestic poultry causing signifi-
cant economic losses particularly to the commercial poultry industry resulting in reduced feed conversion, reduced egg production and significant downgrading of carcasses at slaughter. The disease has a worldwide distribution and is extremely important to both the broiler grower and the table egg producers. Infection of air sacs in broilers (air sacculitis) is the cause for condemnation of dressed birds as unsuitable for human consumption. Laying flocks positive for MG have been shown to produce as many as 20 fewer eggs per year than MG negative flocks (Garcia et al., 2001; Talha, 2003).

With the huge population of chickens being reared and the industry steadily growing, major disease problems of commercial and local chickens have not been well investigated in Ethiopia. There is no documented work on the status and distribution of MG infection in Ethiopia. The objectives of this study, therefore, were to estimate the sero-prevalence of *M. gallisepticum* in commercial and local chicken production systems in East Shewa, Ethiopia, and to assess risk factors for the sero-prevalence.

**Materials and methods**

**Study area**

The study area, East Shewa is located in the center of Ethiopia with area of 14,050.27 km². It has an altitude range of 3100 to less than 1000 meter above sea level (masl). It is located in the middle of Oromia, connecting the western regions to the eastern ones. This zone is bordered on the south by the West Arsii Zone, on the southwest by the Southern Nations, Nationalities and Peoples Region, on the west by South west Shewa and Oromia Special Zone Surrounding Addis Ababa, on the northwest by North Shewa, on the north by the Amhara Region, on the northeast by the Afar Region, and on the southeast by Arsi; its westernmost reach is defined by the course of the Bilate River. Towns and cities in East Shewa include Bishoftu (DebreZeit), Metehara, and Ziway. The town of Adama was separated from East Shewa and is a special zone now. Five woredas were randomly selected: Ada’a, Boset, Gimbichu, Lume, and Adamitulu. Gimbichu lies in the highland with about 2450 masl, Ada’a and Lume fall under mid-high land of 1600-2300 masl, whereas Boset and Adamitulu fall under low land with an altitude range of 1200-1500 masl (https://wikipedia.org/wiki/EastShewaZone, Web retrieved May, 2018).
Study animals

A total of 514 chickens sera were collected (187 from commercial and 327 from local chickens). For local chicken production, chickens were randomly bought from market places of the selected five Woredas, whereas, commercial chickens (layers and broilers) were obtained from the three selected commercial poultry farms in Bishoftu, East shewa, Ethiopia, which were coded, for confidentiality, as farm-A, farm-B and farm-C. The farms undertake regular vaccination against New Castle Disease (NCD), Gumboro (IBD), fowl typhoid, fowl pox, and Infectious Bronchitis (IB). The housing was deep litter system for broilers and layer chicks; whereas, battery cage system for layers. Feeding and watering system was through automatic feeders and waterer. Birds were supplemented with minerals, amino acids, and vitamins produced locally and imported. The layer breeds were of Bovan-Brown, Rod Island Red (RIR), and Lohmann; and broiler breeds were of Cobb-500 and Rose. Layer and broiler flocks of different age were included (Table 1).

Table 1. Study chickens with different age group, sex, and number of samples taken

<table>
<thead>
<tr>
<th>Age group and bird type</th>
<th>Production system</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Commercial chickens</td>
</tr>
<tr>
<td>Broiler</td>
<td></td>
</tr>
<tr>
<td>Grower (3 to 6 weeks)</td>
<td>61</td>
</tr>
<tr>
<td>Finisher (6 to 10 weeks)</td>
<td>42</td>
</tr>
<tr>
<td>Layer</td>
<td></td>
</tr>
<tr>
<td>Chicks (1 to 8 weeks)</td>
<td>32</td>
</tr>
<tr>
<td>Layers (18 to 76 weeks)</td>
<td>52</td>
</tr>
<tr>
<td>Local</td>
<td></td>
</tr>
<tr>
<td>Adult local</td>
<td>-</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>79</td>
</tr>
<tr>
<td>Female</td>
<td>108</td>
</tr>
<tr>
<td>Total</td>
<td>187</td>
</tr>
</tbody>
</table>

In farm-A, both layers and broilers with one flock of layer chicks and one flock of commercial layers, and two flocks of broiler growers and two flocks of broiler finishers were considered; in farm-B, layer flocks with one flock of layer chicks and one flock of commercial layers; and in farm-C, broiler flocks with one flock of broiler finisher and two flocks of broiler growers were considered for the
study (Table 2). None of the commercial chickens were vaccinated against MG infection.

Table 2. Number of commercial chickens (layers and broilers) sampled

<table>
<thead>
<tr>
<th>Commercial chickens</th>
<th>Farm-A</th>
<th>Farm-B</th>
<th>Farm-C</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Layers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chicks</td>
<td>19</td>
<td>13</td>
<td>-</td>
<td>32</td>
</tr>
<tr>
<td>Layers</td>
<td>18</td>
<td>34</td>
<td>-</td>
<td>52</td>
</tr>
<tr>
<td>Broilers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grower</td>
<td>40</td>
<td>-</td>
<td>21</td>
<td>61</td>
</tr>
<tr>
<td>Finisher</td>
<td>16</td>
<td>-</td>
<td>26</td>
<td>42</td>
</tr>
<tr>
<td>Total</td>
<td>93</td>
<td>47</td>
<td>47</td>
<td>187</td>
</tr>
</tbody>
</table>

Study design and sample size determination

Cross sectional study with stratified random sampling was followed. Poultry production system was stratified into commercial and local chicken production systems. In commercial, layer flock chicks (1 to 8 weeks old) and layers (18 to 76 weeks), and broiler flocks with broiler grower (3 to 6 weeks) and finisher flock (6 to 10 weeks) were included for the study. Chickens of both sexes and different age groups were stratified and sampled randomly. In the local chicken production system, an average adult chicken of both sexes were bought from different market places from the selected five Woredas of East Shewa. The effects of sex, age, bird type (layer, broiler), and production system were assessed on the sero-prevalence of *M. gallisepticum* infection. Sample size was determined using Win-episcope 2.0 (Thrusfield *et al*., 2001). The sample size thus, determined was 385; however, maximized to 514 to increase precision. Proportional sampling was followed assuming the dominant system of chicken production in the study area is local chickens and hence, a total of 187 sera from commercial chickens and 327 sera from local chicken were collected.

Sample collection

About 3 to 4 ml of blood sample was collected from the wing vein using 5 ml sterile syringe and needle, and kept at room temperature for 6 to 8 hours until the blood clots. Then, the serum was harvested into sterile cryo-tubes, recorded individually and stored at -20°C until processed at the National Veterinary Institute (NVI), Bishoftu, Ethiopia.
Laboratory methodology

Indirect enzyme linked immune sorbent assay (ELISA) was employed to detect antibodies against MG infection. The antibody ELISA test kit (FLOCK SCREEN Cat. No. V050/V054) GUILDHAY Company, Surrey, England was used. The test procedure was followed according to the manufacturer’s instruction. Unknown test samples were tested in parallel with positive and negative controls.

Data analysis

Data entry was made on MS-excel and analyzed using statistical package: STATA version-intercooled stata 7.0. Summary statistics were used to estimate sero-prevalence of *M. gallisepticum*. Pearson chi-square and univariate logistic regression were used to assess association between risk factors of production system, age, bird type, and sex on the prevalence of MG infection; and significant association at a 95% confidence level and p-value of 5% as statistical significance.

Results

The overall sero-prevalence of *M. gallisepticum* was 49.4% (254/514). The prevalence for local chickens and commercial chickens were 64.5% and 23%, respectively, and the difference was found to be statistically significant (*p*<0.05). The sero-prevalence of MG infection was found to be significantly associated with poultry production systems (*p*<0.05, χ²=82.09, OR=6.09). Risk ratio of 2.8, risk difference of 41.5%, attributable fraction among local chickens of 64.4%, and attributable fraction among population of 53.5%, were recorded.

Of the three commercial poultry farms, prevalence was high in farm-B (46.8%) as compared to the lowest value observed in farm-C (4.25%); this difference was statistically significant (*p*<0.05). Moreover, of the five Woredas, the highest prevalence was observed in Lume (72.7%) and the lowest in Ada’a (47.5%) and this was statistically significant (*p*<0.05) (Figure 1 and Table 3).
Among commercial chickens, significant difference \((p<0.05)\) in prevalence was demonstrated between layers (41.7%) and broilers (7.8%). Age was significantly associated \((p<0.05, \chi^2=55.3, \text{ OR}=3.8)\) with MG sero-prevalence and overall increase in prevalence with increasing age was recorded. In layer flocks, there were no seropositives in chicks between 1 to 8 weeks; however, a prevalence of 67.3% was recorded in layers between 18 to 76 weeks and this was statistically significant \((p<0.05)\). In broiler flocks, prevalence of 6.6% in broiler growers (3 to 6 weeks) and 9.5% in finisher broilers (6 to 10 weeks) was recorded, however, this was not statistically significant \((p>0.05)\).
Sex was significantly associated \((p<0.05, \chi^2=5.11, \text{OR}=1.497)\) with MG sero-prevalence among study chickens with higher prevalence in females (53.8%) than males (43.8%). There was no statistically significant association \((p>0.05)\) between sero-prevalence of MG i and sex of local chickens investigated although it was slightly higher in females (66.5%) than males (62.1%). However, statistically significant association \((p<0.05)\) was observed between sero-prevalence of MG and sex of commercial chickens with 32.5% in females and 10.7% in males. Poultry production system, bird type (broiler and layer) and age were significantly associated with MG sero-prevalence (Table 4).

### Table 4. Summary of OR, 95% CI of OR, and p-values of epidemiological risk factors associated with MG infection using logistic regression

<table>
<thead>
<tr>
<th>Risk factors</th>
<th>OR*</th>
<th>95% CI of OR</th>
<th>SE* of OR</th>
<th>(\chi^2) (LR)*</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production system</td>
<td>6.091</td>
<td>4.046 - 9.17</td>
<td>1.27</td>
<td>85.5</td>
<td>0.000</td>
</tr>
<tr>
<td>Age</td>
<td>2.51</td>
<td>2.05 - 3.08</td>
<td>0.26</td>
<td>135.62</td>
<td>0.000</td>
</tr>
<tr>
<td>Bird type (breed)</td>
<td>8.48</td>
<td>3.655 - 19.68</td>
<td>3.64</td>
<td>31.3</td>
<td>0.000</td>
</tr>
<tr>
<td>Sex</td>
<td>1.497</td>
<td>1.03 - 2.126</td>
<td>0.27</td>
<td>5.11</td>
<td>0.024</td>
</tr>
</tbody>
</table>

OR* = Odds ratio, SE* = Standard error, \(\chi^2\) (LR)* = Chi square of logistic regression

### Discussion

Previous investigations showed that MG infection represents a major problem of chickens reared in commercial poultry farms (Pradhan et al., 2000; Saleque et al., 2003). The study of Talha (2003) demonstrated that MG infections are not only widespread in commercial layer and broiler chickens but also in local (village, backyard) chickens. Similarly, the present study revealed that MG is prevalent in both commercial and local chickens. Although much work has been done on the prevalence of MG infection in chickens in many countries of the world, there are wide variations in the seroprevalence of MG reported due to differences in selecting target population, sample size estimation and tests employed (Talha, 2003). The overall sero-prevalence of MG in the present study (49.4%) was in agreement with the studies of Abdu et al (1983) in Nigeria and Sikder et al (2005) in Bangladesh who reported seroprevalence of 47.5% and 46.9%, respectively. However, the present finding was lower than the investigation of Sarkar et al (2005) who reported a prevalence of 58.9% in model...
breeder poultry farms of Bangladesh. The higher sero prevalence recorded in the local chickens might be attributed to scavenging type of feeding, associated nutritional deficiencies, and lack of disease control program in the local poultry production system which contributed to the increased risk of exposure to MG. Moreover, local chickens can be gathered at different market places which increase the risk of exposure. The local chickens were apparently healthy and could serve as a source of infection for commercial chickens. On the other hand, sero-prevalence was lower in commercial chicken breeds because of better hygienic and management practices, and better disease control program as intensive production system.

The prevalence in commercial chickens (23%) in the present study was higher when compared to the report of Mohammed et al (1986) in central California in commercial pullets and layers (3%) and of Zelenika et al (1999) in Croatia in heavy hen hybrids in 1997 (10%) and in 1998 (13%). On the other hand, the current finding was lower when compared to the findings of Mohammed et al., (1986) in commercial pullets and layers in southern California (73%), Zhang et al (2001) on broiler chickens in Mongolia (53%), and Godoy et al (2001) on layer chickens in Venezuela (66%). The present finding was in agreement with the report of Godoy et al (2001) on layer chickens in Venezuela which was 22%. The prevalence of local chickens (64.5%) in the present study was higher than the study by Kelly et al (1994) in Zimbabwe with a prevalence of 33%, and that of Shah-Majid (1996) in Malaysia with 26% prevalence. However, the current finding of MG sero-prevalence in local chickens was in close agreement with the study of Chrysostome et al (1995) in local chickens in Benin with a prevalence of 62%.

Among commercial poultry farms, the highest prevalence was recorded in farm-B (46.8%) and the lowest in farm-C (4.3%). The highest prevalence recorded in farm-B might be due to being a continuous (multi-age) production site where different age groups of layer flocks were kept in the same farm. Butcher (2002); Talha (2003) and OIE (2004) indicated that MG infection is likely to occur in multi-age production sites, which is common in layer complex and multi age breeder sites. In farm-A, different age groups of layer flocks were kept in houses far apart relative to farm-B. Farms A and C have adapted all-in-all-out principle where the possibility of disease introduction and spread is relatively minimum. Variations observed in prevalence between the farms might also be due to some faulty management and bio-security practices.
In local poultry production, the highest prevalence was recorded in Lume Woreda (72.7%) and the lowest in Ada’a (47.5%). Sarkar et al (2005) demonstrated significant variation in the prevalence of MG infection between districts in Bangladesh. However, the study by Talha (2003) showed no significant difference in prevalence among local chicken flocks investigated at different districts in Bangladesh. Lume Woreda is located on the main road connecting eastern and southern parts of the country to the capital where movement of people and livestock including chickens is high and probably contributing to the highest prevalence of MG recorded in the Woreda.

Age was significantly associated with sero-prevalence of MG where an increasing prevalence with an increasing age was observed. Age variation in sero-prevalence of MG was reported by many authors: Talha (2003) in local (backyard) chickens in Bangladesh reported increasing prevalence with increasing age and also showed that older birds were more seropositive to MG than younger birds, which agrees with the present finding. However, Sikder et al (2005) and Sarkar et al (2005) in model breeder poultry farms in Bangladesh reported a decreasing prevalence with an increasing age which contradicts with the current finding. Association of age with prevalence of MG might be due to an increase in disease risk with an increasing age particularly in commercial production where birds enter into different production stresses as they get older. In the local poultry production system, only the same average adult local chickens were considered and age variation in prevalence was not appreciated.

The prevalence in layer chickens in this study (41.7%) was lower than the report of Godoy et al (2001) in layer chickens in Venezuela, and in commercial pullets and layers in southern California (Mohammed et al., 1986); but higher than the finding of Godoy et al (2001) and Mohammed et al (1986) who reported 22% and 3%, respectively. The prevalence record of broilers in the present finding (7.8%) was lower than the record of Zhang et al (2001) who reported 53% prevalence and close to the finding of Zelenika et al (1999) in heavy hybrids in Croatia with 10% in 1997 and 13% in 1998. The risk of infection in layers was high which might be due to the stress associated with egg production and the multi age production associated in layer flocks where infection is more likely to occur than the all-in-all-out system of production in broiler flocks. The slightly higher prevalence recorded in females in local chickens might be due to the large number of females sampled relative to males. However, significant association between sex and prevalence of MG infection was demonstrated among commercial chickens being higher in females (32.5%) than males (10.7%).
might be due to the fact that female birds are under high stress of egg production. In addition, in multi age production units where mostly female chickens are kept and infection is likely to occur, especially when layer pullets get into the laying complex, might also contribute to the high prevalence recorded in females. This finding agrees with the work of Sarkar et al. (2005) and Sikder et al. (2005) who reported higher prevalence of MG infection in females than males with prevalence of 59.9% and 24.1% in females, and 48.6% and 15.6% in males, respectively.

Conclusion

This study revealed that Mycoplasma gallisepticum (MG) infection is prevalent and widespread in both commercial and local chickens. The highest prevalence in local chickens demonstrated the risk to the huge population of local chickens and might also serve as a source of infection for commercial chickens. These sero-prevalence finding in the present study indicated that the organism is probably circulating among the population of chickens; and it was concluded that this study should be substantiated by isolation and molecular characterization of Mycoplasma gallisepticum in domestic local chickens.

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Conflict of interest

The authors declare that there is no conflict of interest.

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Assessment of the veterinary cost recovery scheme in the Amhara region, Ethiopia

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Abstract

This study was conducted in November, 2015 in selected Woredas of Amhara region with the aim of assessing the impact of veterinary cost recovery on efficiency of public private livestock services and to share the experience of the region with other regional states. Structured questionnaire and a field survey with focus group discussion were applied on a total of 475 randomly selected households. Animal health service in the Amhara region is clearly dominated by the public sector. Private-sector involvement was prominent only in the veterinary drug sales and treatment services. Seventy five percent of livestock owners responded that they received veterinary services from their residence within 1km radius. The results indicated that only 18% of respondents were satisfied by clinical examination provided by public sector. There was wide disparity in the effectiveness of delivery of animal health services between public and private sectors in the study Woredas. Majority of farmers were not been satisfied with the services provided by private sector. The supply of drugs is increasing especially after implementation of veterinary cost recovery scheme but with the limited ranges. Most respondents had positive views regarding availability of veterinary drugs (62.2%) and vaccines (78.1%). Many livestock owners believed that illegal veterinary drug sales have decreased after implementation of veterinary cost recovery scheme (VCRS). The fact that payment for veterinary services has already been adopted by livestock owners in the study Woredas could be considered as a good opportunity to start a full cost recovery scheme as well as pave the way for initiating veterinary privatization in some pilot Woredas.

Keywords: Amhara Region; Drug sales; Private; Public; Revolving fund; Veterinary cost recovery scheme
Introduction

Ethiopia is one of the African countries with the highest livestock population. However, the country is not benefiting from this huge resource due to various reasons. Generally, livestock are of economically and socially important both at the household and national levels, and have in the past provided significant export earnings. Livestock contribute 15 to 17% of GDP and 35 to 49% of agricultural GDP, and 37 to 87% of the household income (EATA, 2013).

Livestock play an enormous role in reducing poverty in the livelihood of the majority of the rural and peri-urban poor. They contribute food and nutritional security; they generate income and are an important storage of wealth, transport and sources of power, and their manure maintains soil fertility (Abebe, 2013). While national data are not available, data from individual contents lead to an estimate of several billion Ethiopian Birr (ETB) in losses in animal products caused by diseases annually. For example, losses because of mortality are estimated between 16 to 20 billion ETB per year. Existing data indicate that the annual production losses (growth, fertility, and work output) due to morbidity could reach 30-50% (Asfaw, 2013).

Full livestock productivity is highly dependent on the availability and provision of high quality and dependable animal health services. However, poor animal health is a major constraint to increasing livestock production in the country. Even though government veterinary institutions traditionally provide basic animal health services, they generally encounter financial shortfalls limiting their ability to deliver sustainable animal health services.

In keeping with the principle of public private partnership in the delivery of veterinary services, the Amhara National Regional State (ANRS) introduced cost recovery scheme to improve the performance of public animal health service delivery, the first of its kind. The program was officially initiated in April 2013 after the regional council endorsed one million ETB to allocate to each administrative Woreda in the form of revolving fund (RF) for purchasing of veterinary drugs and equipment. Since then, there have not been any assessments conducted on the effect of veterinary cost recovery on the delivery of public private services in the region. This study, therefore, was conducted in this particular region with the aim of assessing the impact of veterinary
cost recovery scheme on the efficiency of public private livestock services and shares the experience of the region to other regional states.

Materials and methods

General background on geographical location and livestock potential of Amhara region

The ANRS is located in the North-western part of Ethiopia. Geographically, it is situated between latitude 9°-13°45'N and longitude 36°40'30'E. The total area of the region is estimated at 152,559 km² which is about one-sixth of country’s total area (BoFED, 2006). The region holds a total of 30,037,577 livestock (26% of the national population) that comprises 13,371,486 cattle, 8679,879 sheep, 5,176,309 goats, 2,758,431 equines and 51,472 camels (CSA, 2012). Poor animal health is a major constraint to increasing livestock production in the region. Full livestock productivity is highly dependent on the availability of regular provision of high-quality animal health services.

The information received from Amhara Livestock Resource Development Promotion Agency (2015) indicated that there are 131 Woreda level veterinary clinics, 1956 kebele/village level animal health posts (AHPs), 2 animal disease diagnostic and investigation laboratories, 4 cold chain vaccine stores (not yet functional) and 7 abattoirs (3 export and 4 municipal abattoirs) under the public service sector. The private sector runs 277 clinics and 455 drug shops in the region. The construction of public animal health posts at Kebele level is progressing rapidly. During the study period, 183 public animal health posts were under construction and raising the total number to 2139 in the region. As far as man power is concerned, there are 302 veterinarians (DVM, MVSc) and 3001 veterinary paraprofessionals within public services and 133 veterinarians (DVM) and 699 veterinary paraprofessionals in the private sector.

Selection of the study area and sample size determination

A combination of multistage and purposive sampling methods was used to select the study areas. In the 1st stage administrative zones of the region were divided under two strata to represent productive and food insecure zones. In the 2nd stage target administrative zones were chosen on the basis of their performance of veterinary cost recovery scheme. In the 3rd stage, target Woredas from each zone were selected purposively to represent those which were ac-
tively involved in the cost recovery scheme and those which showed relatively low performance.

Hence, the study was conducted in eight words namely Deben and Awabel of East Gojjam Zone, Bahir Dar Zuria and Gonji of West Gojjam Zone, Fogera and Farta of South Gondar Zone, Meket and Gubalafto of North Wollo Zone of Amhara region. Generally, most part of the study Woredas are midland and are favorable for livestock raising with similar tropical/sub-tropical condition. There are two distinct seasons, the rainy season from June to September and dry season from October to May. In some Woredas (Meket and Gubalafto) there is additional short rainy season between the month of March and May.

In the 4th stage a list of peasant associations (PAs) within Woreda was made from documents obtained from the Woreda’s Agricultural Office and selected three PAs (two rural kebeles and one urban peri-urban) based on accessibility. Then a list of households as a sampling frame was taken from office of Kebele Administrative Council and by using simple random sampling technique 50 households were selected from each PA to participate in the study.

The required sample size for the quantitative data collection was calculated using a formula given by Yamane, (1967) which assumes 95% confidence level and the maximum variance ($p=0.05$). Therefore, a sample size of 400 was considered for this study. In order to accommodate non-response rate and defective questionnaires we added 20% to the calculated sample size and increased the total sample size to 480.

$$n = \frac{N}{1+N(e)^2}$$

Where - $n$ is the sample size, $N$ denotes the population size and $e$ specifies the desired level of precision, where $e = 1 - precision$.

**Data collection**

Both quantitative and qualitative primary data were collected through closed and open-ended questionnaire and interview sessions with the Public and Private Veterinary Practitioners. Target groups for questionnaire survey were livestock producers (farmers, households), private and public veterinary clinics, public animal health posts and private veterinary drug shops. Secondary data were obtained from monthly, quarterly and annual reports of the Amhara
Livestock Resource Development Promotion Agency. Other sources of information were journals, books, internet, publications and government depository.

The level of satisfaction of beneficiaries in the context of accessibility, affordability, sustainability, quality and efficiency of veterinary public or private veterinary service delivery was measured by interview. In addition to this, attempts were made to collect the financial records of the Woreda veterinary clinics and AHPs and the bank statements of the Woreda Finance and Economic Development Offices. Focus group discussions (FGD) were also conducted at Woreda and kebele level to get the opinion of veterinary service providers and beneficiaries, and other relevant actors on veterinary cost recovery scheme.

Data analysis

Collected information was analyzed by the use of the Statistical Package for Social Sciences (SPSS). Qualitative information obtained from key informants was analyzed using content analysis. Descriptive analysis was performed by computing descriptive statistics including frequencies, percentages and minimum and maximum values of ordinal variables.

Results

Revolving fund allocation and utilization

According to data collected from Regional Livestock Resource Development Promotion Agency, 148 Woredas have allocated a total of 101 million ETB as revolving fund (RF) for purchase of veterinary drugs and equipment. However, on average the available fund allocated to each Woreda was estimated to reach 682,432 ETB. At region, the amount of money used for RF scheme increased from 8 million ETB to more than 110 million ETB over the period of 2010-2015.

Demographics of respondents

More than 75% (rural 62.8% and peri-urban 12.3%) of the total respondents were livestock producers, private farms accounted for 5.2%, private veterinary drug shops and clinics (8.6%) and Woreda level veterinary clinic and AHP (11.1%)(Table 1). In terms of sex, about 91% of the HH respondents were male, while female headed HHs account 9% only. With regard to levels of education,
around 25% of HH respondents were illiterate, some 30% have completed adult education and the rest had attended primary and secondary education.

**Table 1. Number of respondents by Woreda and type of veterinary service providers**

<table>
<thead>
<tr>
<th>Woreda Admin.</th>
<th>Farm Household</th>
<th>Private farm</th>
<th>Public</th>
<th>Private</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rural</td>
<td>Peri-urban</td>
<td>Vet clinic</td>
<td>AHP Vet. clinic</td>
<td>Drug shop</td>
</tr>
<tr>
<td>Awabel</td>
<td>50</td>
<td>10</td>
<td>8</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Bahir Dar Zuria</td>
<td>22</td>
<td>10</td>
<td>6</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Bahir Dar City</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Dejen</td>
<td>50</td>
<td>10</td>
<td>7</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Gonji Kolela</td>
<td>50</td>
<td>10</td>
<td>-</td>
<td>5</td>
<td>-2</td>
</tr>
<tr>
<td>Farta</td>
<td>50</td>
<td>10</td>
<td>10</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Fogera</td>
<td>50</td>
<td>10</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Gubalafto</td>
<td>50</td>
<td>10</td>
<td>8</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Meket</td>
<td>50</td>
<td>10</td>
<td>1</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total(%)</strong></td>
<td>397(62.8)</td>
<td>78(12.3)</td>
<td>64(10.1)</td>
<td>6(1)</td>
<td>16(2.5)</td>
</tr>
</tbody>
</table>

**Animal health services**

Of the total of 182 veterinary centers involved in the study, 144 and 38 were government veterinary clinics/AHPs and private veterinary centers, respectively (Table 2). Seventy percent of farmers responded that they received animal health services from public veterinary centers (clinics and/or AHPs). With regard to distance of veterinary centers, majority (75%) of livestock owners responded that they received veterinary services from their residence within 1km radius.

**Table 2. Numbers of veterinary facilities by type in the study Woredas (2015)**

<table>
<thead>
<tr>
<th>S</th>
<th>Sector</th>
<th>Clinics and/or AHPs (%)</th>
<th>Drug shops (%)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public</td>
<td>144 (78%)</td>
<td>0 (0%)</td>
<td>144 (78%)</td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td>21 (12%)</td>
<td>17 (10%)</td>
<td>38 (22%)</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>165 (90%)</td>
<td>17 (10%)</td>
<td>182 (100%)</td>
<td></td>
</tr>
</tbody>
</table>

Attempts were made to rank veterinary services in relation to farmers’ choices. Thus, majority (96%) of farmers rank public as first choice followed by private animal health clinic and then private drug shop (Table 3).

Table 3. Ranking public and private animal health services

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Public</th>
<th></th>
<th>Private</th>
<th></th>
<th>Private drug shop</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency %</td>
<td>Frequency %</td>
<td>Frequency %</td>
<td>Frequency %</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>First</td>
<td>453</td>
<td>96.0</td>
<td>12</td>
<td>2.5</td>
<td>75</td>
<td>15.9</td>
</tr>
<tr>
<td>Second</td>
<td>11</td>
<td>2.3</td>
<td>174</td>
<td>36.9</td>
<td>2</td>
<td>0.4</td>
</tr>
<tr>
<td>Third</td>
<td>2</td>
<td>0.4</td>
<td>32</td>
<td>6.8</td>
<td>150</td>
<td>31.8</td>
</tr>
</tbody>
</table>

Revenue collection

The computed annual average service revenue for Awabel, Dejen, Fogera and Meket was 8972.00 ETB, 7361.4ETB, 5010.2ETB and 68.7ETB, respectively. It gives a maximum of 8972.0ETB for Awabel and a minimum of 68.9 ETB for Meket Woreda. The service revenue from total sales for the sampled Woredas ranged from 5% (Meket Woreda) to 22% (Fogera Woreda). With regard to gross revenue, 85% and 78% were generated from drug sales for Awabel and Fogera Woreda, respectively. In Meket Woreda, 95% of revenue was generated from sales of drugs.

Level of satisfaction of farmers to animal health services

As shown in Table 4, 10.6%, 18.0%, 20.6%, and 21.0% of respondents scored satisfactory for treatment, clinical examination, vaccination and other services provided by public sector/AHP/, respectively. Almost 56.0%, 26.0%, 11.3% and 6.1% of farmers scored satisfactory, poor, good and very good for the services they obtained from private sector, respectively.
Table 4. Level of satisfaction of farmers with services delivered with public animal health posts (AHPs)

<table>
<thead>
<tr>
<th>Animal health services</th>
<th>Very good (%)</th>
<th>Good (%)</th>
<th>Satisfactory (%)</th>
<th>Poor (%)</th>
<th>Missing (%)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical examination</td>
<td>6 (1.3)</td>
<td>43 (9.1)</td>
<td>85 (18.0)</td>
<td>75 (15.9)</td>
<td>263 (55.6)</td>
<td>472 (100)</td>
</tr>
<tr>
<td>Vaccination</td>
<td>171 (36.2)</td>
<td>153 (32.4)</td>
<td>97 (20.6)</td>
<td>24 (5.1)</td>
<td>27 (5.7)</td>
<td>472 (100)</td>
</tr>
<tr>
<td>Treatment</td>
<td>204 (43.2)</td>
<td>186 (39.4)</td>
<td>50 (10.6)</td>
<td>10 (2.1)</td>
<td>22 (4.7)</td>
<td>472 (100)</td>
</tr>
<tr>
<td>Other services</td>
<td>159 (33.7)</td>
<td>134 (28.4)</td>
<td>99 (21.0)</td>
<td>47 (10.0)</td>
<td>33 (7.0)</td>
<td>472 (100)</td>
</tr>
</tbody>
</table>

Most respondents (62.2%) had positive views regarding availability of veterinary drugs in public veterinary services. The result showed that 78.1% of respondents are satisfied with the accessibility of vaccines in the area. Moreover, available data indicated that the number of animals treated in the region was increasing after the implementation of veterinary cost recovery scheme (2013-2015) compared to previous years. The same is true for vaccination. Table 5 shows total number of animals treated and vaccinated between the years 2011 and 2015 in the Amhara region.


<table>
<thead>
<tr>
<th>Year</th>
<th>Vaccinated</th>
<th>Treated</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>10.0</td>
<td>15.0</td>
<td>25.0</td>
</tr>
<tr>
<td>2012</td>
<td>9.4</td>
<td>11.5</td>
<td>20.8</td>
</tr>
<tr>
<td>2013</td>
<td>11.2</td>
<td>17.6</td>
<td>28.8</td>
</tr>
<tr>
<td>2014</td>
<td>20.8</td>
<td>19.0</td>
<td>39.8</td>
</tr>
<tr>
<td>2015</td>
<td>23.3</td>
<td>23.4</td>
<td>46.70</td>
</tr>
</tbody>
</table>


Survey results indicate that more than 63% of the private practitioners replied that obtaining license is not a challenge. According to information obtained from the regional Livestock Resource Development and Promotion Agency (LRDPA), the number of private drug shops in the region has increased by 50% and that of private clinics tripled over the past three years.
Discussion

This survey shows that each sample Woreda allocated one million ETB as a RF except Gonji Kollela which had about 306,000 ETB to run the VCRS. This measure has considerably reduced the budgetary burden which has not been adequately funded for veterinary inputs purchase by LRDPA in previous years.

Majority (70%, n=332) of farmers received animal health services from government veterinary centers a finding that agrees with works of Moorhouse and Tolossa (1998). With regard to accessibility, it was observed that most private veterinary centers (clinics and drug shops) were established in major cities and towns. Many farmers (75%, n=356) received veterinary services from their residence within 1km radius. This shows that the construction of public animal health posts at kebele level is progressing rapidly and so that clinical service is provided to livestock owners at nearby public veterinary centers.

Majority (96%) of farmers ranked public veterinary service as first priority followed by private animal health clinic and then private drug shop as their overall preference for veterinary service delivery. Similarly, a study on animal health service delivery in North Gondar showed that 58.5% of respondents preferred the government service, 21.4% liked both services equally and 20.3% preferred the private service (Kebede et al., 2014).

Respondents during the Focus Group Discussions (FGD) clearly mentioned that accessibility, affordability, quality and sustainability of veterinary services are factors for preference. The study revealed that 84% (n=399) of farmers can afford to pay service and drug sale charges to public veterinary center in comparison with charges to pay to private centers. However, 87% (n=29) of livestock producers in Dejen Woreda considered the prices charged to be acceptable in private clinics. It was also observed that the issue of affordability was challenging for government to provide rapid and effective clinical veterinary care in drought affected Woreda such as Gubalafto.

Before the introduction of VCRS, clinical services that were provided by government clinics were predominantly subsidized or provided free in the region. Users were required to cover only the cost of drugs. Under the new arrangement, livestock owners are required to pay for the services they get and a margin of 15% on drugs. The result showed that most of the animal health service providers at Kebele level did not have veterinary drug dispensers who provide
both professional services and cash collection. This has created a burden on the animal health professionals and affected the speed of service provision. It also creates a room for malpractices.

In most cases the service fee collected was highly understated as compared to physical performance or services provided (clinical examination, close castration). In addition to this, the average service revenue per clinic in the Meket Woreda was below one ETB per day. Major reasons for little service revenue include lack of commitment to collect payment for clinical examination as per the VCRS guideline, lack of drug dispenser, poor monitoring and evaluation system, absence of timely audit and lack of training on revenue collection, recording and reporting.

The public involvement in provision of clinical and laboratory examination services at Kebele level was poor. This might be associated with lack of adequate clinical and laboratory equipment. Most veterinary workers assigned in AHPs have lack of training and their efficiency decreased over time. With regard to level of satisfaction, majority of farmers had not been satisfied with the services provided by private sector. In most FGDs many farmers believed that the private drug shops and clinics have no genuine products and also doubtful about the shelf life of drugs sold by these centers. This clearly demonstrated that there is lack of awareness and misconceptions regarding veterinary privatization on the part of livestock keepers.

At initial stage of the program, it was challenged that most beneficiaries had not fully understood as to why they need to pay for services. It was obvious that farmers were accustomed to government subsidization and were reluctant to pay for veterinary services. This, in turn, led to less revenue for the RF, insufficient for the purchase of large quantity of inputs. After farmers’ participation and full understanding of the program, sufficient amounts of money were collected that enabled bulk purchases. Even though there was no budgetary constraint for purchase of drugs in government veterinary clinics, there was problem of administering the RF such as absences of purchase plan to ensure steady supply of drugs in all sample Woredas. As a result of this, considerable number of veterinary clinics had encountered inadequate supply of veterinary drugs besides getting diversified veterinary products, which is also pronounced throughout the region.
The introduction of the veterinary cost recovery scheme has minimized the price gap between public and private AHS providers. The unfair competition due to subsidized or free service has reduced. However there is still difference in price as well as service charges between the two sectors and this could change when full cost recovery scheme is introduced.

Analysis of result indicates that 26.3% (n=10) of the private practitioners were discouraged by VCRS. The reasons given by them include moon-lighting public sector staff and failure to enforce rules, poor inspection and control system on public veterinary clinics and AHPs, poor linkage between public and private sectors, unfair government veterinary drug cost. In general, the public sector has not been very successful in regulating the malpractices. Supplementary income of public sector staffs through moon-lighting was the major problem in the implementation of VCRS. The research team proofed that there was wide variation for instance between numbers of castrated animals reported and amount of money collected from the service provided. Evidence suggests moon-lighting public sector staff, some 25% of public animal health staff admitted to supplementing their salary through private out-of-hours work, this is surely the ‘tip of the iceberg’ (Moorhouse, 2013).

**Conclusion**

This study revealed that the supply of veterinary products particularly drugs to Woredas is increasing after implementation of veterinary cost recovery scheme. However, there are very limited range and quality of veterinary products that cannot improve the quality of veterinary services in the region. Payments for veterinary services have already been adopted by livestock owners in the study Woredas which is a good opportunity to start a full cost recovery scheme and pave the way for initiating veterinary privatization in some pilot Woredas. The accessibility of veterinary drugs in public sectors has reduced and closed down the illegal trading of veterinary products advertised by personnel with limited technical competence. In other aspect, lack of inspection and control of moon-lighting by public animal health staffs discourage many legal veterinarians and para-veterinary professionals. It is very important to establish periodic monitoring and evaluation system of veterinary cost recovery scheme in the region. The VCRS guidelines and/or directives should be revised in order to solve matters which create confusion.
Acknowledgements

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Conflict of interest

The authors declare that there is no conflict of interest.

References


In vitro efficacy of diazinon and amitraz on Boophilus decoloratus tick at Sebeta Awas district, Ethiopia

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Abstract

This study was conducted in Oromiya region, western Shewa Zone, at Sebeta Awas district, Ethiopia to determine the in vitro efficacy of Amitraz 12.5% and Diazinon 60% against Boophilus decoloratus using adult immersion test. A total of 180 engorged adult female ticks of B. decoloratus were collected from local cattle under extensively managed herds and immersed in Amitraz 12.5% and Diazinon 60% at field recommended concentration and in distilled water for control groups for 1 minute and then incubated at 27 ± 1°C and relative humidity of 85% for 7 days. The oviposition response of B. decoloratus in both groups were observed at regular interval. The mean mass of eggs laid by B. decoloratus of the treated group and those of untreated groups was compared to estimate the efficacy of each tested acaricide. Thus, B. decoloratus treated with Diazinon 60% at field recommended concentration died and did not lay eggs while some of B. decoloratus which were treated with Amitraz 12.5% at field recommended concentration survived and as a result eggs were found in seven days incubation time. There was a statistically significant variation (p <0.05) between the two acaricides in the overall oviposition control of B. decoloratus tick species. On the other hand those treated with water as a control group were able to survive and lay many eggs. Diazinon 60% at field recommended concentration was better in overall mean percent control (C%=100) than Amitraz 12.5% (C%=98.27) of B. decoloratus at field recommended concentration. The results of the study suggested that both Amitraz and Diazinon provide higher oviposition inhibition on B. decoloratus tick. Further study in relation with the in vivo trial is recommended.

Keywords: Acaricides; Boophilus decoloratus; Efficacy; In vitro testing
Introduction

Ixodidae Ticks are very important vectors for transmission of many bacterial, viral and protozoan pathogens of human, livestock and wild animals (Estrada-Peña et al., 2004). Tick infestation presents a serious challenge to farmers of ruminants in both developed and developing countries (Jongejan and Uilenberg, 2004). Ticks which are considered to be most important to the health of domestic animal in Africa comprise about seven genera. Among these the main tick genera found in Ethiopia includes Amblyomma, subgenus Rhipicephalus (Boophilus), Haemaphysalis, Hyalomma and Rhipicephalus (Walker et al., 2003). Among 60 tick species found infesting both domestic and wild animal of Ethiopia, 30 species have been widespread and are important parasites of livestock and cause significant economic losses to the livestock industry (Gebre et al., 2004). *Boophilus decoloratus* is a one-host tick, which is indigenous to Africa and presumably evolved as a parasite of ungulates in East Africa and may have found its way south with the migration of indigenous tribes and their livestock. Cattle are its main domestic hosts although heavy infestation may also occur on horses and wild ungulates. Other domestic animals appear to be much less important as hosts (Mekonnen et al., 2002). *Boophilus decoloratus* showed no marked preference for any particular attachment site and it completes the parasitic phase of its life cycle within three weeks on the same host. The short life cycle allows the tick to pass through several generations in one year (Norval, 1994).

In tropical Africa, tick and tickborne diseases are economically very important diseases next to trypanosomosis (Tiki and Addis 2011). *Boophilus decoloratus* transmits *Babesia bigemina*, which causes red water in cattle (Heyne, 1986). As *B. decoloratus* is a one-host tick, it can be effectively controlled by three-weekly acaricide treatment of cattle. Zebu cattle develop a considerably better host resistance to this tick than European breed cattle and require fewer acaricide treatments (Norval, 1994). This tick species is important not only as vectors of various pathogens but also because it quickly develops resistance to a wide range of acaricides. The development of resistance in this species was usually the main reason for the introduction of new acaricides (Walker, 1991).

Ethiopia, despite owning the largest livestock number in Africa due to disease derived by microbial and parasitic agents, food shortage, less productive local livestock breeds, poor management system (Zijlstra, 2015), the livestock sector is not contributing to the economy of the country as expected. The contribution
of livestock to the national economy with regard to foreign currency earnings through exporting live animal, meat, offal, partially and completely finished leather and leather products is significant (CSA, 2013). Ticks harm the hosts both directly and indirectly. Direct harm results from blood loss, damage to hides and skins, serving as route for secondary infection, production of toxin and causing paralysis (Walker et al., 2003). Indirectly, ticks cause economic loss by playing an important role as vectors for transmission of several tick-borne diseases (TBDs), reduced productivity and fertility, anemia and death (Eyo et al., 2014).

The aim of tick control campaign is not to control all ticks simultaneously, but a definite species because of its particular role (FAO, 2004). The currently available tools for tick control consists of acaricides relying on treatment with different application methods and/or formulations, tick resistant animals, tick vaccines, TBDs vaccines and management interventions. The successful implementation of rational and sustainable tick control program in grazing animals is dependent up on a sound knowledge of the ecology or epidemiology of the parasite as it interacts with the host in specific climatic, management and production systems (Walker, 2011). In most situations, however, efficient and reliable control of ticks and TBDs are still based primarily on intensive use of acaricides, often without the local understanding of those responsible factors for tick distribution dynamics (Brito et al., 2011). Tick treatment relying on different application methods have been the main method of tick control in Africa, leading to numerous problems; environmental pollution, development of resistant tick strains and escalating costs (Walker, 2011).

Resistance is generally first recognized as failure of a drug to control parasitism but the formal definition of resistance is a shift in the target species susceptibility to a drug (Sangster, 2001; Corley et al., 2013). World Health Organization Scientific Group (1965) has developed the definition of resistance in broad terms as “the ability of a parasite strain to survive and/or to multiply despite the administration and absorption of a drug given in doses equal to or higher than those usually recommended but within the limits of tolerance of the subject”. Such a general definition could be accepted as a basis for discussions on acaricide resistance (Rao et al., 2014).

To alleviate these problems, the most frequently used techniques to detect resistance in cattle tick are the adult immersion test (AIT), larval packet test (LPT), and larval immersion test (LIT). However, for the success of any tick
management strategy, it is necessary to use a test that is practical, quick, economical and reliable to detect presence of resistance in target population (FAO, 2004). The escalation of acaricide resistance in ticks has encouraged the establishment of different acaricide resistance testing methods. The commonest reason for controlling ticks on livestock is to prevent and control important tick borne diseases such as anaplasmosis, babesiosis, cowdriosis and theileriosis.

Some livestock herds may be subject to serious threat from two or more of these diseases and this has led to substantial use of tick control systems, mostly relying on chemicals that kill ticks. This has contributed greatly to development of the livestock industry in Africa (Latif and Walker, 2004). Likewise, in Ethiopia, over the past decades ticks are mainly controlled by using variety of acaricides; including organochlorines, organophosphates, carbamates, amidines or synthetic pyrethroids. However, with the most widespread, under or over concentration and frequent use of organochlorine and organophosphate compounds, ticks are likely to develop resistance in Ethiopia (Mekonnen, 2001). Continuous studies on dynamics of tick population with the efficacy status of acaricides against the most abundant and important tick species in particular area are necessary to carry out efficient tick control and/or tick burden reduction (Gebre, 2001). Hence the objective of the present study was to evaluate the efficacy of Amitraz (12.5%) and Diazinon (60%) acaricides against adult engorged female ticks of *B. decoloratus* under *in vitro* condition.

**Materials and methods**

**Study area**

The study was conducted from November 2016 to April 2017 at Sebeta located in the Oromia special zone, Oromia region, Ethiopia Addis. Sebeta is located at 25 km south west of Addis Ababa at a latitude and longitude of 8°54′40″N and 38°37′17″E, respectively. It has an elevation of 2356 m.a.s.l and has annual mean rain fall range from 860 to 1200 mm. The mean annual minimum and maximum temperature is 8°C and 19°C, respectively (CSA, 2011). In and around Sebeta town, different species of livestock are kept. The farming system is a mixed crop-livestock production system where draft-oxen are used for plowing to produce crops. The livestock population of the district are 6395, 1702, 1123, 1157, 922 cattle, sheep, goat, horse, mule, donkey and poultry respectively (Sebeta Awas Agricultural Office, 2016).
Study population

Local cattle found in and around Sebeta town were target population. Animals were selected based on the following selection criteria: on their infestation level with engorged adult female ticks and those cattle which did not receive acaricide treatment one month before the trial. Totally from 40 cattle herds, 120 cattle were selected for female adult engorged tick collection. All animals were kept under extensive management system.

Sample size and sampling method

For the Adult immersion Test, the general practice has been to use a minimum of 10 engorged female ticks for each acaricide and the same for controls, but 20 ticks for each trial would be preferred (FAO, 2004). Thus, for this test a total of 180 engorged adult female *B. decoloratus* ticks with no signs of injury and color changes were collected and three groups of twenty ticks were randomly formed (Group I for Amitraz, Group II for Diazinon and Group III for control/water). This set up was then covered and incubated in an incubator at temperature of 27°C±1 and relative humidity (RH) maintained at 85%. Three replicates were used for each acaricide.

Acaricides

The choice of acaricides used was based on their commercial availability and patronage by farmers, veterinary clinic and drug stocks at Sebeta Awas district. According to the information obtained from the farmers, the most frequently used acaricide were Amitraz 12.5% and Diazinon 60%. Amitraz 12.5% was manufactured by Adami tulu pesticides processing Share Company (Ethiopia) and Diazinon 60% was manufactured by KAFR EL ZAYAT pesticides and chemicals Company Egypt. These acaricides were stored and used according to the manufacturers' guideline.

Study methodology and design

The study areas and herds with high tick infestation were selected and ticks were removed carefully by hand from the body sites. All visible and fitted engorged adult female ticks for trial were collected from 40 naturally infested local cattle herds. From each herd, 3 or 4 cattle, based on their infestation level with engorged adult female ticks, a total of 120 cattle were selected. At each
collecting site, cattle were restrained, and adult engorged female ticks of any species (as it is difficult to identify the tick species at collection site) were collected from the sampled cattle (Ducoenez et al., 2005).

**Adult immersion test (AIT)**

The AIT was used to test fully engorged females, of size greater than 4.5 mm (Drummond et al., 1973), under standard laboratory conditions of 28°C and 85% relative humidity. Acaricidal products containing the following active ingredient as the single Amitraz (12.5%) and diazinon (60%) were tested separately using the AIT.

These products were commercially available and used in accordance with the manufacturer’s recommendations and following the commercial dosages of active ingredient used by farmers. Each test was performed in duplicate with 20 females per group, with an average tick weight of 250 mg. The ticks were immersed for 1 minute in the solution containing the acaricide diluted in distilled water, after which they were dried with absorbent paper and transferred to Petri dishes.

The indicated concentration for Diazinon is 0.06% while that of Amitraz is 0.025%. The formula, \( V_1C_1 = V_2C_2 \) was used to prepare the concentration of acaricides, where \( V_1 \) and \( V_2 \) are the volume of the acaricide to be drawn from the stock product and the final volume after reconstitution, respectively, \( C_1 \) and \( C_2 \) are the stock product concentration and the required final concentration after preparation, respectively. For all the preparations, the final volume was 1000 ml.

A controlled bioassay design was used to evaluate the efficacy and egg laying suppression effect of Amitraz and Diazinon against *B. decoloratus* under *in vitro* condition. The FAO (2004) modified protocol for the AIT and as suggested by (Drummond et al., 1973) was used to conduct bioassay using a commercial acaricides at the recommended field concentration by the manufacturer.

To estimate the efficacy of each acaricide, both groups (treated and control) were then tested using the egg laying test (ELT) method (Drummond, et al., 1973 and modified by FAO, 2004) which involves the comparison of the egg mass of ticks treated with acaricide and the egg mass of untreated ticks and finally estimates the percentage control value, using the following formula:
Percent control = \( \frac{\text{MEC} - \text{MET}}{\text{MEC}} \times 100 \)

Where, MEC and MET are mass of eggs laid by control ticks and treated ticks, respectively.

**Data management and analysis**

All collected data were entered into Microsoft Excel 2007. Statistical analyses were carried out using SPSS version 20. Data were analyzed using descriptive statistics in the first step; Percent control (%C) obtained with Egg Laying Test (ELT) for each acaricide were used to evaluate its effectiveness whereas, independent sample t-test was used to examine mean Percent Control between acaricides. A p-value less than 0.05 at 95% confidence intervals was considered as significant.

**Results**

The oviposition response of female engorged *B. decoloratus* after immersion in Amitraz 12.5% and Diazinon 60% in three replicates is presented in Table 1.

**Table 1. Mean oviposition of engorged female *B. decoloratus* after immersion in manufacturers’ recommended concentration of Amitraz 12.5% and Diazinon 60% EC after seven days of incubation.**

<table>
<thead>
<tr>
<th>NT</th>
<th>Tt</th>
<th>NIFT</th>
<th>EW</th>
<th>NTS</th>
<th>Av.EMPTG</th>
<th>PC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Diazinon (60%)</td>
<td>20</td>
<td>4.90</td>
<td>0</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Amitraz (12.5%)</td>
<td>20</td>
<td>4.95</td>
<td>10</td>
<td>0.010</td>
<td>98.72</td>
</tr>
<tr>
<td></td>
<td>Control (water)</td>
<td>20</td>
<td>4.80</td>
<td>20</td>
<td>0.781</td>
<td>0.00</td>
</tr>
<tr>
<td>2</td>
<td>Diazinon (60%)</td>
<td>20</td>
<td>5.05</td>
<td>0</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Amitraz (12.5%)</td>
<td>20</td>
<td>4.92</td>
<td>9</td>
<td>0.018</td>
<td>98.19</td>
</tr>
<tr>
<td></td>
<td>Control (water)</td>
<td>20</td>
<td>4.85</td>
<td>19</td>
<td>0.995</td>
<td>0.00</td>
</tr>
<tr>
<td>3</td>
<td>Diazinon</td>
<td>20</td>
<td>5.01</td>
<td>8</td>
<td>0.022</td>
<td>97.90</td>
</tr>
<tr>
<td></td>
<td>Amitraz</td>
<td>20</td>
<td>4.95</td>
<td>20</td>
<td>1.050</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>20</td>
<td>4.95</td>
<td>20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NB:** NT (No of trial), Tt (Treatment), NIFT (Number of immersed female ticks), EW (Engorgement weight (gram), NTS (Number of ticks survived after 7 day incubation, Av.EMPTG (Avg.egg mass per treatment group (gm) and PC (Percent control (%C))
In the trial, none of *B. decoloratus* treated with Diazinon laid eggs, while few *B. decoloratus* treated with Amitraz laid small batch of eggs with mean weight of 0.017 gm. There was a statistically significance variation (*p*<0.05) between the two acaricides in the overall oviposition control of *B. decoloratus* tick species (Table 2).

However, *B. decoloratus* tick species in the control group laid relatively large batch of eggs with mean weight of 0.942 gm. The overall mean %C of Amitraz and Diazinon, and their respective standard deviations as well as their minimum and maximum mean efficacy during the three replication of the trial is presented in (Table 3). Diazinon 60% showed evidence of better effect on oviposition of *B. decoloratus* (*p*< 0.05).

### Table 2. T-test analysis of mean percent *B. decoloratus* oviposition control between Amitraz 12.5% and Diazinon 60% EC at recommended concentration.

<table>
<thead>
<tr>
<th>Ticks</th>
<th>Acaricide</th>
<th>Mean %</th>
<th>N</th>
<th>SD</th>
<th>t-value</th>
<th>Df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>B. decoloratus</em></td>
<td>Diazinon 60%</td>
<td>100</td>
<td>3</td>
<td>0</td>
<td>4.43</td>
<td>4</td>
<td>0.0114</td>
</tr>
<tr>
<td></td>
<td>Amitraz 12.5%</td>
<td>98.27</td>
<td>3</td>
<td>0.667</td>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

N=Number of trial; %C=Percent control; SD=Standard Deviation; df=difference

### Table 3. Overall mean percent oviposition control of Amitraz 12.5% and Diazinon 60% EC at field recommended concentration and their standard deviation against adult female *B. decoloratus*.

<table>
<thead>
<tr>
<th>Acaricide</th>
<th>minimum efficacy</th>
<th>maximum efficacy</th>
<th>mean efficacy ±SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diazinon 60%</td>
<td>100</td>
<td>100</td>
<td>100±0</td>
</tr>
<tr>
<td>Amitraz 12.5</td>
<td>97.19</td>
<td>98.72</td>
<td>98.27±0.677</td>
</tr>
</tbody>
</table>

### Discussion

Several authors have studied the efficacy of Amitraz and Diazinon on different tick populations using AIT. The results showed different susceptibility levels. In most of the studies, Amitraz revealed high degree of tickicidal efficacy that agreed with the present finding. Similarly, a closely comparable finding, %C of 98 to 100, was reported by Mekonnen *et al* (2001) at Sebeta, Ethiopia. In Wolaita and Dawuro zone, Ethiopia, Asha and Eshetu (2015) also reported mean efficacy of 91.79% for Amitraz at the same dilution rate. In South Africa, Mekonnen *et al* (2002) also reported 100% efficacy for Amitraz. Moreover, Souza *et al* (2003) in southeast Brazil and Eshetu *et al* (2013) in Borena, Ethiopia.
obtained mean Amitraz efficacy of above 95%. On the other hand lower efficacy was reported by Mendes et al (2001) who showed an average efficacy of 77.4% and Furlong et al (2007) reported efficacy of 47.9% for Amitraz. In northeast region of Brazil, a low efficacy of Amitraz, with efficacy of 48.4% and 30.9% was reported by Brito et al (2011) and Campos and Oliveira (2005), respectively.

In most of the studies, Diazinon revealed lower degree of tickicidal efficacy than Amitraz. However, it is higher in the present finding which is 100%. Eshetu et al (2013) in Borena, Ethiopia obtained mean Diazinon efficacy of about 80.1%. In Wolaita and Dawuro zone, Asha and Eshetu (2015) also reported mean efficacy of 65.3% for Diazinon. There is no high efficacy variation between the two presently tested acaricides in this study. But there is a slight variation in oviposition response. In the trial, none of *B. decoloratus* treated with Diazinon (60%) laid eggs, while few *B. decoloratus* treated with Amitraz (12.5%) lay small batch of eggs.

The use of acaricide at inappropriate concentration is one of the prime factors which affect the efficacy of an acaricide and contributes to failure of tick control. During this study, farmers complained of failure of acaricides to kill ticks after being treated and reported that the acaricide was not working. Especially, this coincided with the period during which heavy tick burdens were present on cattle. *In vitro* laboratory tests, however, indicated that those acaricides that were mostly used for tick control in the study area had high acaricidal efficacy of 98.3% for Amitraz and 100% for Diazinon. The result in this study is suggestive of good performance of both acaricide against *B. decoloratus* and the reason for the complaint by the livestock keepers in the area could be due to faulty preparation, dilution, storage and application of acaricides in accordance with the manufacturer’s recommendation.

**Conclusion**

The current study revealed that Diazinon 60% at field recommended concentration provides relatively a higher oviposition response inhibition of *B. decoloratus* than amitraz 12.5% at field recommended concentration. In the present study, the two acaricides have conserved their efficacy on *B. decoloratus* tick species in the study area. Further tests using different tick species and other efficacy evaluation methods involving larval and lymphal stages as well as *in vivo* efficacy trial at field level should be conducted to assess the residual ef-
fect of these acaricides. Awareness creation to farmers on the proper usage of acaricides is also recommended.

Conflict of interest

The authors declare that there is no conflict of interest.

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A study on hoof abnormalities among working donkeys presented to veterinary clinics in and around Mekelle, Ethiopia

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Abstract

A study was conducted from November 2013 to May 2014 in three selected sites in and around Mekelle town, Ethiopia. The objectives of the study were to estimate the prevalence of hoof abnormalities in working donkeys and to assess associated risk factors with its occurrence. Severity of lameness was also assessed in relation to types of the abnormalities. A total of 415 working donkeys were randomly selected from those donkeys that visited the stationary and mobile clinics in the study area. History taking and thorough clinical examination were used as a tool to conduct the study. The overall prevalence of hoof abnormality was found to be 14.7%. Trauma was found to be the major (52.5%) type of hoof problem, followed by hoof over growth (19.7%), hoof crack (14.8%) and thrush (13.1%). The occurrence of hoof abnormality was significantly associated with body condition scoring ($p<0.05$) in which it was higher in donkeys with poor body condition. Other factors such as site, age, stable floor type and working time were not significantly associated ($\chi^2=2.016$, $p>0.05$) with the occurrence of the hoof abnormality. Hoof abnormalities identified had resulted in Grade I to IV lameness. Grade 4 lameness was mainly (94.7%) caused by trauma. Grade 3 lameness was caused by trauma (72.2%) and thrush (27.8%). Grade 2 was caused by hoof crack (50.0%), thrush (33.3%) and hoof over growth (16.7%). Grade 1 lameness was due to hoof overgrowth (61.1%) and hoof crack (33.3%) and trauma (5.6%). Generally, it was identified that hoof abnormalities due to trauma, thrush, hoof over growth and hoof crack were a health problem of working donkeys in the study area. Community awareness enhancement on prevention and management of hoof abnormalities is recommended.
Keywords: Clinical examination; Hoof abnormalities; Lameness; Prevalence; Risk factors.

Introduction

The hoof is the horny covering over the distal end of the third digit. It has a complex three dimensional structure and consists of a horny capsule. It is made up of the wall and bars, the sole, the frog and the bulbs of the heels. The hoof capsule thus forms a coherent, resilient boot, such that distortion of any particular part affects the remainder (Hepworth et al., 2004; Davies and Philip, 2007; Frandson et al., 2009). The wall makes up the largest part of the hoof capsule and it has a major function in weight bearing. The bars are the parts of the wall that have turned inward from the heels to surround the frog. The sole is also composed of tubular and inter tubular horn and is produced from tissue overlying the base of the pedal bone. The frog is a readily recognized V-shaped structure with its narrowest part pointing forward. The bulbs of the heels are the softer, rounded regions of horn immediately above the heels of the hoof wall (Pilliner et al., 2004; Svendsen, 2008).

Hooves are subjected to several injuries when animals are either out in the pasture or while they are being ridden or driven. Most commonly encountered equine hoof problems among others are thrush, hoof crack, equine canker and white line disease (Christopher et al., 2000; Booth and White, 2007). Thrush is the term commonly used to describe a pododermitis of the frog caused by Fusobacterium necrophorum. Hoof cracks are fractures of hoof capsule that are named after their location. Equine canker is a hypertrophic, moist dermatitis of the frog and the bulbs of the heel. White line disease is most commonly an incidental finding at the time of routine trimming and shoeing. It appears as a localized separation of the white line and further exploration with a probe or shoeing nail often reveals undermining of hoof wall (Christine, 2004; MacDonald et al., 2006; Booth and White, 2007). Mechanical trauma due to stone and punctures with sharp objects and over grown hooves are all common types of hoof wall problems (Christopher et al., 2000; Booth and White, 2007).

Hoof lesions can cause a wide spectrum of clinical presentations that range from very subtle losses of performance to sever lameness (Kempson, 1990; Keegan and Dyson, 2003). Although an animal with hoof problem may be able
to function, chances are that optimal animal production and performance can be reduced depending on the severity of the problem (Hepworth et al., 2004). The hoof is an extremely important structure in animal body (Reilly, 1995). Disorders of the hoof have important health and welfare implication in donkeys. Hoof abnormalities and the resultant lameness can signal suffering and leads to increased energy expenditure, reducing ability to work and income for donkey-owners (Keegan and Dyson, 2003; Iqbal et al., 2006). Generally, hoof is essential for locomotion and overall wellbeing of donkeys. Majority of lameness in equine arises from hoof problem (Baxter, 2011). The distribution of hoof abnormalities is thought to vary depending on different risk factors. The situation in Ethiopia has not been well addressed in general and there has been no study conducted in and around Mekelle particularly on hoof abnormalities to the authors’ best knowledge. Therefore, the objectives of this study were to estimate the prevalence of hoof abnormalities and assess risk factors associated with its occurrence in working donkeys and identify the types of abnormalities and its impact in causing lameness.

**Materials and methods**

**Study area**

The study was conducted in and around Mekelle city namely, Mekelle, Adigudom and Quha. Mekelle is the capital city of Tigray Regional State and it is located in the northern part of Ethiopia at 13° 29’ North latitude and 39° 28’ East longitude with an altitude of 2,000 to 2,270 meters above sea level. The mean annual rainfall ranges from 450 mm to 600 mm. The mean minimum temperature ranges between 10.2°C and 12.6°C, while, the mean maximum temperature varies between 22.3°C and 26.7°C (Niguse, 2015). The total population of horses, donkeys and mules were 2,412, 69, 2179 and 4690 respectively in Tigray region (CSA, 2013). Of this, Mekelle city possess about 1,200 horses, 1,792 donkeys and 223 mules (MOUA, 2013).

**Study population**

Randomly selected 415 working donkeys that were presented to the donkey sanctuary clinics to receive veterinary service such as deworming and treatment against various diseases in Mekelle, Adigudom and Quha during the study period were included in this study. These donkeys play major role in the area as a pack animal. All were local breed.
Sample size determination and sampling technique

The sample size required was determined by the formula stated in Thrusfield (2007) based on 50% expected prevalence, 95% confidence level and 5% of absolute precision.

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

Where  
- \( N \) = required sample size 
- \( P_{\text{exp}} \) = expected prevalence 
- \( d \) = desired precision 

\[ Z = 1.96 \text{ for 95% confidence interval.} \]

\[ n = 1.96^2 \times 0.5(1-0.5)/0.05^2 = 3.84 \times 0.25/0.0025 = 384 \]

Therefore to study the prevalence of hoof abnormalities and associated risk factors in working donkeys in and around Mekelle city, a minimum of 384 working donkeys are required. Owners who presented their donkeys seeking various clinical services were registered at the beginning. They all were informed about the purpose of the study and about the sampling procedure. After their willingness was confirmed each donkey was identified using systematic random sampling with a target of seven to ten donkeys per clinic visit. Accordingly, a total of 415 donkeys were included from the three sites.

Study design

A study was conducted from November 2013 to May 2014 on selected working donkeys that were presented to the donkey sanctuary clinics in and around Mekelle town, Ethiopia. A check list was used to collect data on causes, management practices such as stable floor and risk factors associated with hoof abnormalities such as site, sex, frequency of use of donkeys, and body condition score. Body condition scoring was based on the guideline given by Svendsen (2008). Thorough clinical examination was used as a tool to identify hoof abnormalities.

Clinical examination

Physical clinical examination was undertaken according to Baxter (2011). Visual examination, examination by manipulation and palpation were used in the diagnosis of the foot abnormalities. The foot was inspected for any hoof over growth, signs of cracks, discharge, injury and poor conformation and
palpated for signs of increased heat and pain detection. Hoof tester, hoof pick and hoof knife were used during the examination. The donkeys were examined at rest and in motion.

Careful examination of donkeys at rest was conducted by first observing animals at distance followed by close visualization from front, sides and behind to assess symmetry of hoof problem, conformation, the condition and alteration of posture, weight shifting and pointing followed by close observation of each limb. At close examination, each foot was examined with the leg in the weight-bearing position. These include: palpation of the palmar digital vein, artery, and nerve bundle, examination of the heel bulb area, viewing and palpation of the coronet, palpation and careful examination of the entire hoof wall for any defect. This was followed by examination of the foot in the non-weight-bearing position which involves examination of the frog, the bars, the sole and the white line.

Examination of donkeys in motion was conducted to identify the limbs involved and the degree of lameness and coordination in movement. Each selected donkeys were examined while it was walking and trotting. The degree of lameness was categorized in to four according to Baxter(2011): grade 1, grade 2, grade 3, and grade 4 depending on level of severity of lameness in increasing order.

Data management and analysis

The data collected from the owners and results of clinical examination was entered in to the Microsoft excel spread sheet and it was analyzed using SPSS version 20 statistical software. Descriptive statistics were used to quantify the hoof abnormalities and Chi-square (χ²) was used to determine the association of the abnormalities with the risk factors. Prevalence of hoof abnormalities was estimated as proportion of donkeys with hoof abnormalities out of the total donkeys examined. In all calculations, the confidence interval was set at 95% and statistically significant difference was considered at \( p<0.05 \).

Results

A total of 415 working donkeys consisting of 369 males and 46 females were included in this study. The overall prevalence of hoof abnormalities among donkeys that visited veterinary clinics during the study period was 14.7% (n=61). The majority (43, 70.5%) of the hoof abnormalities was observed on forelimbs
as compared to the hind limbs. The hoof problems identified include; injury/trauma, hoof over growth, hoof crack and thrush as depicted in Table 1.

Table 1. Type and proportion of hoof abnormalities among working donkeys in and around Mekelle town (n=415)

<table>
<thead>
<tr>
<th>Type of abnormality</th>
<th>No of donkeys with hoof abnormality</th>
<th>percent</th>
<th>Chi-square</th>
<th>(p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injury or trauma</td>
<td>32</td>
<td>7.7</td>
<td>4.15</td>
<td>0.000</td>
</tr>
<tr>
<td>Hoof over growth</td>
<td>12</td>
<td>2.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hoof crack</td>
<td>9</td>
<td>2.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thrush</td>
<td>8</td>
<td>1.9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Statistically significant difference in the occurrence of the hoof abnormalities was observed only among the body condition scores and stable floor whereas the difference in other factors such as site, sex and frequency of use of donkeys were not significantly associated with the occurrence of hoof abnormalities as indicated in Table 2.

With regard to the frequency of use of donkeys, the majority (194, 46.7%) of the owners replied that it is difficult for them to tell the exact frequency of use of their donkeys as they use some times intensively and other time less frequently. One hundred sixty (38.6%) owners replied that they use their donkeys on daily basis. The remaining 37 (8.9%) and 24 (5.8%) owners use their donkey one to six days in a week and one to three days in a month, respectively.

Hoof abnormalities identified had caused different degrees of lameness. Grade 1 lameness was mainly due to hoof overgrowth and hoof crack. Grade 2 was associated with hoof crack, thrush and hoof over growth. Grade 3 and 4 lameness was caused by trauma and thrush. The detail is described in Table 3.
Table 2. Association of hoof abnormalities in relation to site, sex, body condition score floor type and frequency of use of donkeys

<table>
<thead>
<tr>
<th>Risk factors</th>
<th>Total No examined</th>
<th>Abnormalities No(%)</th>
<th>Chi-square</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quiha</td>
<td>168</td>
<td>23(13.7%)</td>
<td>2.02</td>
<td>0.365</td>
</tr>
<tr>
<td>Adi-gudum</td>
<td>180</td>
<td>31(17.2%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mekelle</td>
<td>67</td>
<td>7(10.5%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>369</td>
<td>57(15.4%)</td>
<td>0.28</td>
<td>0.159</td>
</tr>
<tr>
<td>Female</td>
<td>46</td>
<td>4(8.7%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body condition</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>98</td>
<td>32(32.7%)</td>
<td>33.36</td>
<td>0.000</td>
</tr>
<tr>
<td>Moderate</td>
<td>187</td>
<td>19(10.2%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>130</td>
<td>10(7.7%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stable</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earthen floor</td>
<td>286</td>
<td>49(17.1%)</td>
<td>4.35</td>
<td>0.037</td>
</tr>
<tr>
<td>Concrete floor</td>
<td>129</td>
<td>12(9.3%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency of use</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>194</td>
<td>32(16.5%)</td>
<td>1.28</td>
<td>0.735</td>
</tr>
<tr>
<td>Daily</td>
<td>160</td>
<td>20(12.5%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-6 days in a week</td>
<td>37</td>
<td>6(16.2%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-3 days in a month</td>
<td>24</td>
<td>3(12.5%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3. Severity of lameness in relation to types of hoof abnormalities

<table>
<thead>
<tr>
<th>Types of abnormalities</th>
<th>Grade of lameness</th>
<th>No. (%)</th>
<th>No. (%)</th>
<th>No. (%)</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Grade 1</td>
<td>Grade 2</td>
<td>Grade 3</td>
<td>Grade 4</td>
<td></td>
</tr>
<tr>
<td>Trauma</td>
<td>1(5.6)</td>
<td>-</td>
<td>13(72.2)</td>
<td>18(94.7)</td>
<td></td>
</tr>
<tr>
<td>Thrush</td>
<td>-</td>
<td>2(33.3)</td>
<td>5(27.8)</td>
<td>1(5.3)</td>
<td></td>
</tr>
<tr>
<td>Hoof over growth</td>
<td>11(61.1)</td>
<td>1(16.7)</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Hoof crack</td>
<td>6(33.3)</td>
<td>3(50.0)</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>18 (100)</td>
<td>6 (100)</td>
<td>18(100)</td>
<td>19(100)</td>
<td></td>
</tr>
</tbody>
</table>
Discussion

In the present study, the overall prevalence of hoof abnormalities in working donkeys was 15%. This result is comparable with 16.3% report from Hawassa, Ethiopia by Assefa et al (2017). More than half of these abnormalities were injury or trauma due to different factors. This was followed by hoof over growth, hoof crack and thrush. Donkeys travel long distance under rugged terrain environment. This might have contributed to the occurrence of high level of injury compared to other types of abnormalities such as hoof crack, hoof overgrowth and thrush. The presence of the second more common abnormality, hoof overgrowth, might indicate lack of regular proper hoof trimming practices as hoof overgrowth in most of the cases is not considered as a major problem by the donkey owners. The low proportion of thrush in this study might be due to the absence of conducive stable environment for the survival and multiplication of the causative organism.

In the current study, the prevalence of hoof abnormalities was found higher (70.5%) in the fore limbs compared to the hind limbs (29.5%). In contrary to this, Assefa et al (2017) and Bolbol and Saleh (1987) reported higher prevalence in the hind limbs. This might be due to the difference in use and the owners’ attitude toward their donkeys. Assefa et al (2017) indicated beating on hind limb as a cause of lameness in donkeys used for pulling carts which is not the case in the current study animals, where donkeys were used as pack animals.

The present study found that, hoof abnormalities were significantly higher in donkeys with poor body condition as compared to those with moderate body condition and good body condition. This result is in agreement with other studies (Broster et al., 2009; Burn et al., 2010). This might be due to the fact that donkeys with hoof abnormality are unable or not comfortable to move freely and graze or search for feed. This might have resulted in reduced feed intake and the subsequent poor body condition or possibly it might be due to increased energy expenditure on locomotion.

In this study, the proportion of donkeys with more severe (Grade III and Grade IV) form of lameness due to the hoof abnormalities was high (60%). This implies the compromise of health and welfare of donkeys due to the hoof abnormalities is significant.
Conclusion

This work presents hoof abnormalities as one of the health and welfare problems in and around Mekelle town, Ethiopia. The hoof abnormalities identified were injury or trauma, hoof overgrowth, hoof crack and trash. These abnormalities resulted in Grade I to Grade IV lameness. Hoof abnormality in working donkeys is one of the major health and welfare concern contributing to reduced work performance. Therefore, community education and awareness enhancement about health and welfare of donkeys including regular inspection of the hoof of donkeys and immediate visit of veterinary clinics should be practiced to alleviate hoof problems. In addition, further study on hoof abnormalities should be conducted in different working groups of donkeys.

Acknowledgements

We gratefully acknowledge Donkey Health and Welfare Tigray project and all its staff members for their cooperation and technical support in accomplishing this research.

Conflict of interest

The authors declare that there is no conflict of interest.

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Short communication

A case of miliary tuberculosis in a Holstein Fresian dairy cow, Mekelle, Tigray, Ethiopia

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Abstract

We report a case of miliary tuberculosis (TB) found in one of the commercial dairy farms in Mekelle, Tigray, Ethiopia. The case history of the cow indicated weight loss, emaciation and chronic cough. Antibiotic treatment was not successful and there was also repeated death of cows in the farm. Postmortem (PM) examination showed tuberculous lesions in the lung, liver, mediastinal lymphnodes, mesenteric lymphnodes, pleural cavity, reproductive tract, lymphnodes of the head and bone marrow suggesting miliary form of TB. This was confirmed by bacteriological examination and histopathology. The farm where the present case was reported is one of the dairy farms in Mekelle city that supplies milk to the community. As the pasteurization facility is weak in the area, it is suspected that this farm may serve as one of the major transmitters of TB in humans. The lack of control policy in the country worsens the occurrence and spread of TB in animals. In this case, the owner of the Farm was advised to conduct tuberculin skin testing and segregate TB positive cows. Moreover, the owner was advised that it is advantageous to slaughter the reactors under the supervision of the local veterinarian so as to reduce spread of bovine TB in the farm.

Keywords: Bovine tuberculosis; Dairy cattle; Exotic; Mekelle; Miliary TB

Introduction

Ethiopia has one of the largest cattle populations in Africa, with an economy highly dependent on its livestock. To improve nutrition and food security, the Ethiopian government is trying to increase milk production with an intensive breeding programme to increase the number of exotic (Holstein) dairy cattle that produce more milk than indigenous breeds (Shapiro et al., 2015). Evi-
Evidence indicates that the *Bos taurus* breeds are more susceptible to bovine TB than zebu cattle (Ameni et al., 2003a). Moreover, intensification of the farming system aggravates the spread of the infection (Ameni et al., 2006). Therefore, the programme of increasing milk yield by introducing Holstein breed can be affected by increasing incidence of bovine TB.

Most of the surveys carried out in Ethiopia have been based on tuberculin skin testing and abattoir inspection. Among the recently undertaken studies, the prevalence rate of bovine TB ranges from 3.4% in a small holder production system to 50% in intensive dairy productions in various regions of the country (Ameni and Roger, 1998; Asseged et al., 2000; Ameni et al., 2003a,b). In Ethiopia, due to the growing population which resulted in an increase in milk demand, intensive dairy cattle production systems with exotic breeds are emerging. However, the exotic breeds are more susceptible to diseases like bovine TB than the zebu breed and the presence of bovine TB in a small scale intensive farm has a detrimental effect on the economy and sustainability of the farm. Therefore, the economic loss due to bovine TB in these farms is very high as the exotic breeds are very expensive. In this paper we report a case of miliary tuberculosis found in one of the commercial dairy farms in Mekelle, Tigray, Ethiopia.

**Case history**

Since one of the missions of Mekelle University, College of Veterinary Medicine, is providing community and consultancy services to the public in the Region, the College has close interaction with the commercial dairy and poultry farmers. On May 25, 2010 the College received a phone call from one of the dairy farms requesting to perform a postmortem examination on one dairy cow. A Holestein Frenesian dairy cow aged around 10 years has suffered from a chronic illness. The clinical history of the cow shows chronic coughing, emaciation, decline in appetite and decreased milk production. It has received antibiotic treatment several times but was not successful. Additionally, the clinical history and health management of the herd was assessed. Repeated death of dairy cows after chronic coughing and emaciation was reported by the farmer.
Postmortem findings, acid fast staining and histopathological examination

Postmortem examination of the dairy cow was conducted and showed tuberculous lesions in the lung, liver, mediastinal lymphnodes, mesenteric lymphnodes, pleural cavity, reproductive tract, lymphnodes of the head and bone marrow. Disseminated miliary TB was noted as depicted in Figure 1.

Figure 1. An incised mediastinal lymph node showing tubercle with calcified caseous exudates

Typical tubercle lesion was found in the mediastinal lymphnode. The lung contains multiple coalescing foci of caseous necrosis surrounded by thin pale fibrous tissue capsules (tubercles) (Figure 2).
Figure 2. Extensively affected lung tissues with diffuse pus and tubercle lesions as well as adhesion to the pleural cavity due to fibrinous inflammation

When the lung was dissected very thick pus and the tubercles were observed. The pleural cavity was full of pale fibrous tissue capsules (tubercles) (Figure 3). The bone marrow was also found full of pus. In the present case, pulmonary involvement was highly pronounced (that is, the whole lung tissue was affected significantly). In addition, granulomatous lesions were found widely spread in the peritoneum, mesentery, liver, kidneys, intestines and mesenteric lymph nodes.
Pus from the intestines and smear from the granulomatous lesions were collected and examined for detection of acid fast bacilli. Acid-fast bacteria typical of mycobacteria were detected in the smear samples. Tissue samples from tuberculosis lesions from different tissues were processed, sectioned and stained following standard histological technique (Bancroft et al., 1988). Microscopic examination of hematoxylin and eosin stained slides revealed granulomatous inflammation, with epitheloid cells surrounding the central necrotic area, lymphocyte infiltration, giant (multinucleated) cells at periphery and fibrous encapsulation (Figures 4 and 5).
Figure 4. Hematoxylin and Eosin stain of lung tissue under low magnification (x10) showing necrotic tissue center surrounded by epitheliod cells, an indication of granulomatous inflammation.

Figure 5. Hematoxylin and Eosin stain of lung tissue (x40 magnification) showing giant (multinucleated cells) indicated with arrows.

Discussion

Bovine TB is a chronic infectious disease of animals characterized by the formation of granulomas in tissues and organs, more significantly in the lungs, lymph nodes, intestine and kidney including others. In many countries, TB in
animals, generally due to infection with *M. bovis*, is of significant economic and zoonotic importance (O’Reilly and Daborn, 1995; Cousins and Dawson, 1999).

The predominant clinical sign in the present case was severe emaciation and weight loss. The owner also reported for repeated cases of emaciation, weight loss and coughing in the previous years. This suggests that aerosol transmission of the disease from infected cows to the healthy ones. This is basically facilitated due to confinement of animals and lack of regular testing and isolation of infected animals. As differential diagnosis John’s disease and deficiency of trace elements (Selenium/vitamin E) were suspected as ill-thrift and weight loss is a feature of each of this conditions. However, the absence of diarrhea, postmortem findings and laboratory results helped us to exclude John’s disease and selenium/vitamin E deficiency (Radostits *et al*., 2000). Tentative diagnosis of TB on the basis of clinical signs was confirmed using post mortem examination, with confirmatory bacteriology and histopathology tests. The widespread distribution of tubercle bacilli in different organs and tissues like lung, liver, mediastinal lymphnodes, mesenteric lymphnodes, pleural cavity, reproductive tract, lymphnodes of the head and bone marrow confirmed miliary form of TB.

Cases of TB in cattle due to *M. bovis* are more common than any other animal species. The disease is more significant in exotic breed than the zebu breed (Ameni *et al*., 2006). The repeated death of exotic cows in this farm is an indication for the economic importance of the disease. The zoonotic importance of the disease is also of significant value as there is report of *M. bovis* cases in humans in the country (Kidane *et al*., 2002). In countries where BTB in cattle is still prevalent and where pasteurization is not widely practiced, usually about 10% to 15% of human TB is considered to be caused by BTB (Ashford *et al*., 2001).

**Conclusion**

BTB is an endemic disease that has long been documented in Ethiopia. The incidence of the disease is higher in intensive dairy farms and exotic breeds. The farm where the present case was reported is one of the dairy farms in Mekelle City that supplies milk to the community. As the pasteurization facility is weak in the area, it is suspected that this farm may serve as one of the major transmitters of TB in humans. Thus, the observation of a case of miliary TB in a dairy cow substantiates the previous reports of high prevalence of BTB in
dairy farms in the country and warrants for the attention to seek for an applicable control strategy.

Acknowledgements

The authors acknowledge Mekelle University, College of Veterinary Medicine for provision of material support for the case investigation.

Conflict of interest

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References


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- Review articles
- Short communications

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tate the review process give line numbers in Arabic numerals. Give also page number in the lower middle of each page, starting from the title page.

**Title page**

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The second page should provide an abstract of not more than 300 words summarizing the background, objective, materials and methods, major findings and their significance, and conclusions. Avoid the use of undefined abbreviations.

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Conclusion

This section should be separately presented with supporting evidences based on the major findings of the study. Appropriate recommendations can be made if necessary.

Acknowledgements

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