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ARTICLES

Research Articles

- Causes of organ condemnation, its public health and financial significance in Nekemte municipal abattoir, Wollega, Western Ethiopia** 205
Lati Efrem, Biresaw Serda, Berhanu Sibhat and Eyob Hirpa
- Trypanosomes and helminths infections in Mayo Rey Division of Cameroon and impact of concurrent infections on cattle** 215
Mamoudou Abdoulmoumini, Pierre Fongho Suh and Ebene Njongui Jean
- Prevalence of endoparasitic helminths of donkeys in and around Haramaya district, Eastern Ethiopia** 221
Biniam Tsegaye and Abdisa Chala
- Susceptibility pattern of aerobic bacteria isolated from septicemic cattle in Adama, Ethiopia** 225
Ayalew Assefa
- Caprine Coccidiosis: An outbreak in the Green Mountain in Libya** 229
M.A.M. Sharif, M.M.A. Alagab, I.M. Eldaghayes, A.M. Kammon and A.S. Dayhum
- Parasitological and serological study of camel trypanosomosis (surra) and associated risk factors in Gabi Rasu Zone, Afar, Ethiopia** 234
Weldegebrial Gebrezgabher Aregawi, Samson Terefe Kassa, Kidanie Dessalegn Tarekegn, Woldegebriel Tesfamariam Brehanu, Sisay Tilahun Haile and Fikre Zeru Kiflewahid
- Prevalence of bovine fasciolosis in and around Inchini town, West Showa Zone, Ada'a Bega Woreda, Central Ethiopia** 241
Abdi Assefa, Zerihun Assefa, Desta Beyene and Fanta Desissa

Full Length Research Paper

Causes of organ condemnation, its public health and financial significance in Nekemte municipal abattoir, Wollega, Western Ethiopia

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A cross-sectional study was conducted from October, 2013 to April, 2014 on cause of organ condemnation, its public health and financial significance in Nekemte municipal abattoir in East Wollega zone, Oromia regional state of Ethiopia. The overall objective was to determine the cause of organ condemnation, its public health and financial significance due to fasciolosis, hydatidosis, *Cysticercus bovis* and other causes. Accordingly, a total of 534 randomly selected slaughtered cattle were examined both during antemortem and postmortem. There were many physical abnormalities such as localized swelling 12(2.25%), laceration 2(0.37%), branding 21 (3.93%), lameness 11(2.06%), abrasion 4(0.74%), nasal discharge 7(1.31%), and lacrimation 5(0.94%). During postmortem, inspection organs were condemned due to fasciolosis [liver 65(12.17%)], hydatid cyst [liver 94(17.6%), lung 65(12.17%)], *Corynebacterium bovis* [heart 8(1.49%) and carcass 2(0.37%)]. The chi² analysis of potential risk factors revealed that there was statistically insignificant difference in age, altitude and body condition between animals from different origin ($P > 0.05$). The total annual direct financial loss from organ condemnation due to hydatidosis, fasciolosis, *C. bovis* and other causes was estimated to be 1,056,155.05 Ethiopian Birr (ETB) annually = 52807 USD. The result of this study revealed that hydatidosis (12.73%) is the major disease causing direct economic losses significantly in the study area followed by fasciolosis (12.7%) and cysticercosis (2.4%).

Key words: Hydatidosis, fasciolosis, *Cysticercus bovis*, Nekemte.

INTRODUCTION

The livestock sector globally is highly dynamic, contributes 40% of the global value of agricultural output, and support the livelihoods and food security of almost a billion people (Thornton 2010). In Ethiopia, livestock

production is an integral part of the agricultural system. The livestock sub sector accounts for 40% of the agricultural gross domestic product (GDP) and 20% of the total GDP without considering other contribution like

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traction power, fertilizers and mean of transport (Aklilu et al., 2003). The livestock population of Ethiopia is the largest in Africa and ranks ninth in the world. The livestock subsector accounts for about 45 percent of the agricultural GDP and about 18 percent of the total GDP (Blench et al., 2003).

Beyond their direct role in generating food and income, livestock are a valuable asset, serving as a store of wealth, collateral for credit and an essential safety net during times of crisis (MoA, 2006; FAO, 2009). Livestock and livestock products are the major foreign exchange earners. The only second to coffee with hides and skins contributing the most, however, currently the overall livestock production constraints in Ethiopia are feed shortages, livestock diseases, low genetic potential of indigenous livestock, and lack of marketing infrastructure and water shortages (Markos, 1999; Alemayehu, 2009). Additionally, each year a significant loss results from death of animals, inferior weight gain and condemnation of edible organs and carcass at slaughter during routine meat inspection. This production loss to the livestock industry is estimated at more than 900 million USD annually (Abebe and Yilma, 2012; Ezana, 2008).

Diseases cause extensive financial wastes as a result of direct and indirect economic losses, is the major concern to livestock industry. In abattoirs of various locations, researchers indicated that hydatidosis is widespread in Ethiopia with great economic and public health significance (Jobre et al., 1996; Kebede et al., 2009a to d; Kebede, 2010). Major parasitic disease such as fasciolosis, hydatid cyst, cysticercosis and other causes like abscessation and cirrhosis are of great public health concern and cause significant economic losses by lowering productivity of cattle and condemnation of edible organs (Biu and Adindu, 2004; Chhabra and Singla, 2009). Among the major causes of organ condemnation in the Ethiopia are hydatidosis as discussed by Yifat et al. (2011), Alemu et al. (2012), Alembrhan and Haylegebriel (2013), fasciolosis (Mulat et al., 2012; Bekele et al., 2014), cysticercosis (Bekele et al., 2010; Mesfin and Nuraddis, 2012) and other causes of organ condemnation (Alemayehu et al., 2012; Alembrha and Haylegebrie, 2013). Studies conducted in different abattoirs of Ethiopia revealed that parasitic infection of livers, lungs (pneumonia), pericarditis and pyelonephritis are the major cause of organs condemnation (Asmare et al., 2012). The activity also provides vital data and valuable information on the incidences and prevalence of animal diseases and conditions within the country (Edwards et al., 1997; Ansari-Lari and Moazzeni, 2006; Phiri, 2006). Parasites in the tropics are responsible for far greater losses to meat industry than other diseases. Similarly like many other tropical countries of Africa, it is well known that parasitic diseases are among the major factors responsible for the low productivity of livestock in Ethiopia (Kidanu, 2011).

Echinococcosis is a major public health problem in

some countries, and it may be emerging or re-emerging in some areas. Approximately 2 to 3 million human cases are thought to occur worldwide (CFSPH, 2011). Cysts or lesions of Echinococcosis multilocularis occur primarily in the liver and grow slowly but with eventual serious liver pathology and high risk of mortality if untreated. As well, the cysts occasionally rupture and cause severe allergic reactions in humans (OIE, 2004). Cystic echinococcosis is clinically related to the presence of one or more well delineated spherical primary cysts most frequently formed in liver and then in the lungs and other organs such as kidney, spleen, heart, brain and bone. Tissue damage and organ dysfunction results mainly from this gradual process of space occupying displacement of vital host tissues, vessels or parts of organs. Accidental rupture of cysts can be followed by a massive release of cyst fluid and hematogenous or dissemination of protoscolices. Occasionally this results in anaphylactic reactions and multiple secondary cystic echinococcosis (Gottstein and Reichen, 1996).

Cysticercosis (formerly known as Beef Measles) causes small cysts in the muscles of cattle and their presence can lead to all or part of the carcass being condemned. Cattle get *Corynebacterium bovis* from ingesting foodstuffs contaminated with eggs passed from humans. Sometimes the tapeworm affects human health, but often it goes undetected. In rare cases the cystic intermediate stage can lodge in the brain of people and cause serious disease (Chowdhury et al., 2014). Factors that increase the risk of cattle being infected with *C. bovis* include grazing on land that has human faecal contamination, over flowing domestic sewage systems, irrigation with inadequately treated reclaimed sewage water, bird movements to and from a nearby sewage treatment works (Filmer, 1999).

Bovine cysticercosis has little effect on animal health, but it is economically important disease as it causes carcass condemnation arising from heavy infestation with the cysticerci of taenia saginata as well as the cost of inspecting meat, the necessity to freeze or boil infected meat and losses may also occur from restriction of exports of live animal and animal products. The presence of cysticerci in muscles is not associated with clinical signs; however, the adult tape worm in man produced diarrhea, hunger pain, abdominal discomfort, constipation and nausea (Mesfin and Nuraddis, 2012).

Fasciolosis is an important parasitic disease of domestic ruminants caused by two liver fluke species: *Fasciola hepatica* and *fasciola gigantica* (Trematoda). *fasciola hepatica* has a cosmopolitan distribution, mainly in temperate zones, while *fasciola gigantica* is found in tropical regions of Africa and Asia. The disease is responsible for considerable economic losses in the cattle industry, mainly through mortality, liver condemnation, reduced production of meat, milk, and wool, and expenditures for anthelmintics (Rahmeto et al., 2008). The purpose of meat inspection is to protect public

health and to provide risk free products to the society. Also, it provides information that can be utilized for animal diseases control. Abattoir data is an excellent option for detecting diseases of both economic and public health importance (Arbabi and Hooshy, 2006; Fufa et al., 2010) especially in ascertaining the extent to which human is exposed to certain zoonotic diseases and estimating the financial implications of carcass condemnations (Jobre et al., 1996).

Recently, several modern abattoirs like Helimex, Elfora, Metehara, Modjo and Luna have been established in Ethiopia. This increase number of abattoirs shows increase in demand of carcass and organs supply, but the supply is decreasing due to disease and production problems. In view of this, proper evaluation of economic losses due to organ condemnation resulting from various diseases at abattoirs is needed (Ezana, 2008).

According to the information gained from Nekemte veterinary clinic and Nekemte municipal abattoir, there is no registered information on cause of organ condemnation, its public health and financial significance in the study area. Therefore, the objectives of these studies are; to identify the major cause of organ condemnation in Nekemte municipal abattoir; to estimate financial significance due to organ condemnation in the area; and to identify public health problem regarding organ condemnation.

MATERIALS AND METHODS

Study area

The study was conducted in eastern Wollega zone, western parts of Ethiopia at Nekemte municipal abattoir. Nekemte town is located in Oromia regional state of Ethiopia, which about 33 km far from Addis Ababa. It is located at altitudinal ranges from 2100 to 2250 meters above sea level and geographically it located 09°04'957 N latitude and 36° 32' 928 E longitude. It has different agro-ecological areas namely sub moist, sub moist cool and sub dega. The annual rain fall ranges from 1560 to 2200 mm and the minimum and maximum temperature ranges from 14 to 26°C. Its maximum rainfall occurs from May up to September. Most part of Oromia enjoys excellent climate condition in terms of both temperature and precipitation. This includes cool highlands and warm lowlands. The most prevalent agro-climatic condition varies from locality to locality is tepid to cool in temperature and moist to sub-humid in moisture. The climate of the region is governed by the global air circulation system which is locally conditioned by the topographic condition and the altitude of the location (Hassena and Taa, 1997).

Study animals

The study animal was a cattle brought to the abattoir for slaughter from different distinct around Nekemte town such as Bendira, Diga, Arjo gudetu, Arjo,Uke, Wayu Tuka, Sasiga, Getema and others which was selected with simple random sampling method irrespective of age and sex. The study population constitutes of local and cross cattle breed originating from different localities and markets of the east Wollega zone.

Sample size determination

The total number of cattle for the study was calculated based on the

formula given by Thrusfield (2005) with 95% confidence interval and at 5% absolute precision by using simple random sampling method. In this study, 50% prevalence was considered to calculate the sample size using the following formula. For this particular study the sample size determined at 95% confidence level, 5% precision, and 50% expected prevalence is 384.

$$N = \frac{1.96^2 (p) (1-p)}{D^2}$$

Where, n = sample size, P = expected prevalence, D = desired level of precision (5%).

Therefore:

$$n = \frac{1.96^2(0.5) (1- 0.5)}{0.0025} = 384 \text{ samples}$$

Where n = sample size required, 1.96 = the value of z at 95% confidence level, P exp = expected prevalence, d = desired absolute precision. Hence, the required sample size was 384 cattle presented for slaughter. Even though, the required sample size was 384, additional 150 samples were included to increase the precision and a total of 534 animals were included in the study.

Study design

A cross sectional study was conducted through abattoir survey from October, 2013 to April, 2014 to identify the cause of organ condemnation, its public health and direct financial loss due to organ condemnation in cattle slaughtered at Nekemte municipal abattoir. A total of 534 cattle have been examined by ante mortem and post mortem examination using standard examination procedures.

Study methodology

Antemortem examination

Regular visits were made four (4) days per week to Nekemte municipal abattoirs during the period from October, 2013 to April, 2014. Each week, four days visit was made for antemortem inspection on individual animals for assessment of animals' origins, age and body conditions before the animals were slaughtered. During every visit, each animal were identified based on enumerated code given to the butcher shops before slaughter. The average numbers of animal's slaughtered at Nekemte municipal abattoir were 45 cattle per day and annually around 9360 cattle per annual. Ante mortem inspection was conducted on individual animals while they enter individually and in mass before they entered into the lairage. For the ante mortem inspection, records of age breed and body conditions were done.

Abattoir survey

The cross sectional study, which was based on the abattoir survey, was conducted during detail meat inspection on randomly selected 534 cattle slaughtered at Nekemte municipal abattoir. In this study animals were selected during *antemortem* inspection (AMI) and the related risk factors such as sex, origin, breed and body condition

were recorded before slaughtering. The codes of study animal were properly recoded during AMI that given to the slaughter house.

Questionnaire survey

Questionnaire survey on the cause of organ condemnation, its public health and direct financial loss were administered on 7 volunteer respondents from whom pre-informed consents were obtained. The risk factors of hydatidosis, *C. bovis* and fasciolosis were such as personal character, religion; occupation and the like were requested. Occupationally high risk groups were those who had a strong relationship with meat, meat products and animals, such as, abattoir workers, butcher men, meat inspectors and farmers; whereas, the low risk groups were arbitrarily selected as those who do not have such a strong relationship such as other government and private workers, but all are at risk because of meat consumption.

Postmortem examination

The organs of randomly selected cattle were examined by visual inspection, palpation and incision. Organs of each slaughtered animals infected with hydatid cyst, fasciolosis, cysticercosis and other causes were identified systematically following the standard routine post mortem inspections procedure. The inspected organs were collected for close examination and then registered. Incision was made when necessary to confirm doubtful cases.

Direct financial loss assessment

Annual cost of the condemned organs due to bovine hydatidosis, cysticercosis, fasciolosis and other causes were assessed using the following formula set by (Ogunrinade, 1980). The mean retail market price of condemned organs due to hydatidosis such as liver (80 ETB), lung (20 ETB), heart (65 ETB), kidney (45 ETB), tongue (25 ETB) and carcass 1 kg (140 ETB) were the parameters considered. To assess the economic losses due to fasciolosis, hydatidosis and cysticercosis, only direct economic losses were considered and the calculation was based on condemned organs like liver, lungs, heart, kidney, tongue and carcasses. To calculate cost of condemned edible organs, 7 different butchers, 1 meat inspectors and 12 residents or households in the Nekemte town were interviewed randomly to establish the price per unit organ and the average organ price was determined and this price index was used to calculate the loss (Yifat et al, 2011). The analysis was based on annual slaughter capacity of the abattoir considered, market demand, average market price of each organ in Nekemte town and the rejection rate of specific organ. Information obtaining is subjected to mathematical computation by modifying the formula of Ogunrinade and Ogunrinade (1980).

Annual economic loss due to organ condemnation = $(PI1 \times Tk \times C1) + (PI2 \times Tk \times C2) + (PI3 \times Tk \times C3) + (PI4 \times Tk \times C4) + (PI5 \times Tk \times C5) + (PI6 \times Tk \times C6)$

Where, PI1 = Percent involvement of liver out of the total examined. PI2 = Percent involvement of lung out of the total examined. PI3 = Percent involvement of heart out of the total examined. PI4 = Percent involvement of kidney out of the total examined. PI5 = Percent involvement of Carcass out of the total examined. PI6 = percent of involvement of tongue out of the total examined. C1 = Average market price of liver. C2 = Average market price of lung. C3 = Average market price of heart. C4 = Average market price of kidney. C5 = Average market price of carcass (1 kg) and C6 = Average market price of tongue. Tk = Average annual kill of bovine.

$EL = Sr \times Coy \times Roz$

Where: EL= Estimated annual economic loss due to organs condemnation. Sr = Annual cattle slaughter of the abattoir. Coy = Average cost of each cattle liver/lung/heart/kidney/carcass. Roz = Condemnation rate of cattle liver/lung/ heart/kidney/carcass.

Data management and statistical analysis

Data generated from ante mortem and postmortem meat inspection were recorded in microsoft excel 2010 and statistical analysis was done using STATA 2010 Info version 11 and SPSS version 16.00 program. Descriptive statistics was used to determine the level of organs and carcass condemnation rates defined as proportion of condemned organs and carcass to the total number of organs and carcasses examined. The data obtained during the study was subjected to 95% confidence interval statistical analysis for possible variation between rejection rates of specific organs, origin of animals, body condition, sex of animals and breeds of animals and differences were regarded statistically insignificant; when the 95% confidence interval drawn do not overlap to each other.

RESULTS

Over all prevalence

Out of 534 cattle examined at Nekemte Municipal abattoir 62 (11.61%) had various types of abnormalities during antemortem inspection and the detail of the lists are shown in Table 1.

Majority of breed slaughtered were local breeds however relatively few cross breeds were also slaughtered (Table 2). According to the information obtained from abattoir, averagely 45 cattle's were slaughtered per day and the ages of all animals presented for slaughter were old age which means above 7years old.

Common causes of organ condemnation and financial significance

From the total cattle slaughtered 182(34.08%) liver, 88(16.47%) lungs, 9(1.68%) hearts, 3(0.56%) kidneys, 3(0.56%) tongue and 2 (0.37%) carcasses (Whole carcass) were totally condemned and 12kg of muscle was partially condemned due to pus formation at injection site. The detail of common causes of visceral organs condemnation and the percentage of the condemnation due to the pathological conditions are presented in Table 3. Information collected from Abattoir Butchers, Residents or Households and Meat Inspectors on the mean current price of visceral organs at Nekemte town for liver, lung, heart, kidney and carcass (kg) were 80, 20, 45, 60 and 140 Ethiopian Birr, respectively. The abattoir record from 2011 to 2013 revealed that the mean annual slaughter were 9360 cattle. The total annual direct financial loss incurred due to rejection of visceral organs

Table 1. Disease condition or abnormalities encountered during ante mortem inspection (n = 534).

Condition or abnormalities	No. of cattle affected (%)	Judgment
Localized swelling	12 (2.25)	Judgment passed for slaughter but they need special attentions during PME
Laceration	2 (0.37)	
Brand	21 (3.93)	
Lameness	11 (2.06)	
Abrasion	4 (0.74)	
Nasal discharge	7 (1.31)	
Lacrimation	5 (0.94)	
Total	62 (11.61)	

Table 2. Association of animal origin, breed, sex, body condition, and rejection rate of specific organs (n = 534).

Risk factor	No. of observation	Prevalence (%)	95% CI	X ²	Pv
Sex					
Male	301	132 (24.72)	38.21-49.66	4.61	0.032
Female	233	124 (23.22)	46.59-59.76		
Total	534	256 (47.94)	--		
Origin					
Lowland	120	57 (47.5)	38.31-56.81	1.52	0.467
Midland	370	174 (32.58)	41.84-52.25		
Highland	44	25 (56.81)	41.03-71.65		
Breed					
Local	519	252 (48.55)	44.18-52.94	2.79	0.094
Cross	15	4 (26.67)	7.78-55.1		
Body condition					
Very good	456	220 (48.24)	43.57-52.94	0.15	0.925
Good	72	33 (45.83)	34.02-57.99		
Poor	6	3 (50)	11.81-88.18		

is estimated to be 1,011,020.22 Ethiopian Birr/year. The financial loss due to fasciolosis, hydatidosis, *C. bovis* and other causes are 5200, 8820, 43,095 and 3140 Ethiopian Birr, respectively (Table 4). The total number of organ/carcass condemned at Nekemte municipal abattoir were listed (Table 5) and major postmortem findings during the study are indicated in the work (Figures 1 to 3).

Public health significance

In this study the infected groups for cysticercosis include those who do not eat raw meat and under cooked meat and those who eat raw meat and under cooked meat. The response indicated that groups who eat raw and undercooked meat show high infection rate. The disposal way of infected condemned organ is also on field that

predisposes dogs to hydatidosis and creates the life cycle of parasites to continue.

DISCUSSION

During the study, examinations before slaughtering (antemortem examination) and after slaughtering (postmortem examination) were carried out. Out of 534 cattle physically examined during antemortem inspection in Nekemte municipal abattoir, different abnormalities were found in 62(11.61%) head of cattle. These abnormalities include abrasion 4(0.74%), nasal discharge 7(1.31%), lameness 11 (2.06%), branding 21 (3.93%), lacrimation 5(0.94%), laceration 2(0.37%) and localized swelling 12(2.25%). However, these animals were passed for slaughter with great caution with thorough postmortem examination because some of these different

Table 3. Causes, percentage of organ condemnation and financial losses analysis at Nekemte municipal abattoir (n=534).

Condemned organ	Cause	No. (%) organ condemned	Loss money (Ethiopian birr)
Liver	Fasciolosis	65 (12.17)	5200
	Hydatidosis	94 (17.6)	7520
	Abscessation	4 (0.74)	320
	Cirrhosis	17 (3.18)	680
	Fibrosis	3 (0.56)	120
	Total	183	13840.00
Lung	Hydatidosis	65 (12.17)	1300
	Emphysema	7 (1.31)	140
	abcessation	5 (0.93)	100
	Fibrosis	11 (2.05)	110
	Total	88	1650.00
Heart	<i>C. bovis</i>	1 (0.18)	65
	Hydatidosis	8 (1.49)	520
	Total	9	585.00
Kidney	Fibrosis	3 (0.56)	135
Tongue	<i>C. bovis</i>	3 (0.56)	75
Muscle	Pus	5 kg	700
	Bruise	7 kg	980
	Total	12 kg	1680.00
Carcass	<i>C. bovis</i>	2 (0.37)	42500.00
Total		60,255.00	

Table 4. Findings of the study used in the direct financial loss assessment (n=534).

Organ/carcass	Average rejection rate of organs and carcass (%)	Average of annual Cattle slaughtered	Average price of organ and carcass
Liver	183 (34.26)		80 birr
Lung	88 (16.47)		20 birr
heart	9 (1.68)		65 birr
kidney	3 (0.56)	9360	45 birr
muscle	3 (0.56)		140/kg birr
tongue	3 (0.56)		25 birr
Total carcass	2 (0.37)		140/kg birr

abnormalities either might be symptom of diseases or resulted from the long journey from market area to the abattoir as animals derived on their foot.

The postmortem examination of all organs should be examined for the presence of abnormalities or diseases. From the total of 534 head of cattle slaughtered, organs of 256(47.94%) animals were infected with different parasites or other diseases involving in one or different

visceral organs; that is 65(12.17%) of liver due to only liver fluke and 94(17.6%) of liver due to hydatid cyst, 4(0.74%) of liver due to abscess, 17(3.18%) of liver due to cirrhosis. Similarly, 65(12.17%) of lung due to hydatid cyst, 5(0.93 %) of lung due to abscess, 7(1.31%) of lung due to emphysema and 11(2.05%) of lung due to fibrosis and 8(1.49%) of heart due to *C. bovis* and 1(0.18%) of heart due to hydatid cyst and 3(0.56%) of tongue due to

Table 5. Common causes of visceral organs condemnation and the percentage of the condemnation due to the pathological conditions (n=534).

Organ	No. of cond. organ	Hydt	Fasci	<i>C. bovis</i>	Abscess	Empm	Cirrhosis	Fibrosis	Total
Liver	183	94	65	-	4	-	17	3	183
Lung	88	65	-	-	5	7	-	11	88
heart	9	1	-	8	-	-	-	-	9
tongue	3	-	-	3	-	-	-	-	3
kidney	3	-	-	-	-	-	-	-	3
muscle	3	-	-	-	3	-	-	-	3
carcass	2	-	-	2	-	-	-	-	2

*Hydt = Hydatid cyst, * fasci = fasciolosis, *Empm = emphysema.

**Figure 1.** Hydatid cyst lung.**Figure 2.** Hepatization of cattle lung.

C. bovis and 2(0.37%) of total carcass due to *C. bovis* were rejected because of fasciolosis, hydatidosis, *C. bovis* and others. This might be due to the frequent contact between the infected animals, backyard slaughtering, poor public awareness and factors like difference in culture, social activity and attitude to dogs.

The result of present study recorded is lower than those reported from Addis Ababa abattoirs enterprise by

Dechassa et al. (2012) which is 40.5% and also 34.15% prevalence rate has been reviewed and summarized from abattoir survey over a period of 15 years from Ethiopia (Abebe and Yilma, 2011). The prevalence of the disease in cattle slaughtered at Ambo municipal abattoir was also high (29.69%) (Endrias et al., 2010) and high prevalence of hydatidosis was reported (22.1%) in cattle slaughtered at Tigray region (Weldegiorgis et al., 2008). The variation



Figure 3. Pussation of lung and liver

in prevalence between different countries and regions may be attributed mainly to strains difference in *E. granulosus* that exist in different geographical situations (Arene, 1995).

The finding is similar with the prevalence of disease reported from Burdur (Turkey) 13.5% (Umur, 2003) and from Thrace (Turkey) 11.6% (Esatgil and Tuzer, 2007). This might be due to the abundance and frequent contact between the infected intermediate and final hosts. It could also be associated to slaughtering of aged cattle which have had considerable chance of exposure to the parasitic ova, backyard slaughtering of small ruminants and provision of infected offal's to pet animals around homesteads (locally 'kircha'). Other factors like difference in culture, social activity and attitude to dog in different regions might have contributed to this variation (Macpherson, 1985). Many people slaughter animals at home and allow dogs to eat condemned meat or offals. This Poor public awareness about the disease and presence of few slaughter houses could have contributed to such a higher prevalence rate (annex).

The overall cause of organ condemnation, its public health and financial significance obtained from abattoir in the present study (47.94%) was relatively high and almost higher than the previous reports or findings from Gondar Elfora Abattoir (24.7%) (Yifat et al., 2011). However, the prevalence of hydatidosis was 12.73% which is much lower when compared with several reports from different abattoirs of the country like at Adigrat Municipal Abattoir (18.61%) (Alembrihan and Haylegebriel, 2013), at Southern Wollo abattoir (17.4%) (Alemu et al., 2012). These differences within the country are attributed mainly to variations in the ecological and climatic conditions such as altitude, rainfall, and temperature, although differences in livestock management system and the ability of the inspector to detect the infection may play a part.

Even though the study shows statistically insignificant

variation ($p > 0.05$) with origin, high prevalence rate of major parasites (Liver fluke, hydatid cyst and *C. bovis*) were seen in lowland (2.2%, 6.2 and 0.6%) than the highland (1.7, 2.1 and 0%; and midland (8.8, 15.0 and 1.9%). This might be most of the slaughtered animals originated from midland area, were most likely graze on the field due to decreasing labour and to overcome inefficiency during draught period. And next to midland, lowland animals are likely to have a higher possibility of acquiring infection due to their longer exposure to infection and to lower immunity to combat infection. Additionally, the reason for lower prevalence in highland cattle may be due to lack of free grazing because of human density around highland area.

As reported by Jembere (2002) and Asmare et al. (2012), animals with poor body condition were highly infected with hydatidosis. But the result of the present study of the disease was not in agreement with previous studies. Based on the comparison made among body condition, high infection rate of hydatid cyst were 23.02, 25 and 16.66% from animals with very good, good and poor body conditions respectively. However, the result of study indicated that infection rate has no statistical significance ($p > 0.05$) among the animals with poor (thin), good (medium) or very good body conditions scores.

Comparison made among breeds of animals included in the study shows the prevalence rate of parasites (liver fluke, hydatid cyst and cysticercus bovis) was higher in local (12.5, 74.3 and 2.4%) than cross breed (0.2, 2.4 and 0%), respectively. Similarly, comparison for animals those came from midland (8.8, 15.0 and 1.9%), lowland (2.2, 6.2 and 0.6% and highland (1.7, 2.1 and 0%) for fasciolosis, hydatidosis and *C. bovis*, respectively indicates midland animals were highly attacked by the parasites than lowland and highland, respectively. However, there was no significant variation in prevalence between the three-agro climates at individual level ($p > 0.05$). The direct financial loss incurred during this

study as a result of condemnation of different organs of cattle was estimated about 1,011,020.22 ETB per annual. Therefore, the total annual financial loss due to major parasites in the study abattoir is the summation of losses from organ and carcass condemnation. This finding is by far higher than the result reported by Alemayehu et al. (2012), Alembrhan and Haylegebriel (2013), Shegaw et al. (2009) and Bekele et al. (2014) a total financial loss of about 110,584.046, 19,910.0, 233,501.94 and 88,806.85 Ethiopian birr per annum in cattle due to major cause of organ condemnation at Luna Export Abattoir, Adigrat, Mekelle and Hossana municipal slaughterhouses, respectively. This is probably due to the ecological and climatic difference between those localities.

Conclusion

The study highlights need for investigation to obtain appropriate and more accurate information on the cause of organ condemnation, its public health and financial significance in East Wollega, Nekemte municipal abattoir. The prevalence of hydatidosis/echinococcosis, fasciolosis, *C. bovis* and other abnormalities in cattle presented to Nekemte municipal abattoir, determines the scope and type of relevant control options. The result of this study revealed that hydatidosis and fasciolosis were the most prevalent and major causes of lung and liver condemnation, respectively, whereas *C. bovis* causes condemnation of muscles and carcass. Factors considered including body condition, origin and breed of animals did not show significant association with the rate of organ condemnation. The annual financial loss from east Wollega zone and local market organ condemnation was also estimated high.

RECOMMENDATIONS

In view of the present findings and available information, the following recommendations are forwarded:

1. Awareness generating programs should be given for the meat inspectors, butchers, abattoir workers, and dog owners to the dangers of hydatidosis to human and animal health and appropriate control measure should be taken to stop the sale of infected offals for pet animals' consumption.
2. Government should give attention and build abattoirs with good facilities and control back yard slaughtering and at the center of any control method, is the need to gradually upgrade the traditional husbandry practices to semi or intensive husbandry system and establishment of control programs on helminthosis.
3. The veterinary authority should be carrying out surveillance for hydatidosis, fasciolosis, *C. bovis* and other infection in livestock species in slaughter houses/

abattoirs. When hydatidosis, fasciolosis, *C. bovis* infection is detected an investigation should be carried out by the veterinary authority to identify the origin of the infection and appropriate remedial actions to be implemented.

4. Meat inspection practices should be improved with adequately equipped staff.

Conflict of interest

Authors have none to declare.

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Full Length Research Paper

Trypanosomes and helminths infections in Mayo Rey Division of Cameroon and impact of concurrent infections on cattle

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A survey was carried out to determine the prevalence of gastro-intestinal nematodes and trypanosome infections and their impact on two indicators of cattle health in the Sudano Sahelian Region of Cameroon in June, 2013. A total of 223 cattle were randomly selected from 24 herds and examined for blood parasite infections (parasitaemia) and for gastrointestinal nematode fecal egg counts. The prevalence of helminth infections was 33.62% (95%CI, 27.43 to 39.83%); three types of helminth eggs identified were *Strongyles* (96.30%), *Toxocara* (2.47%) and *Eimeria* (1.23%). The prevalence of trypanosome infection was 9.86% (95% CI, 5.95 to 13.78%); three species of trypanosomes were identified: *Trypanosoma congolense* (81.82%), *Trypanosoma vivax* (13.63%) and *Trypanosoma brucei* (4.54%). Seven animals were found with concurrent infections. Cattle with concurrent infections had a lower mean Body Condition Score than those with trypanosomes or helminths infections alone. The effect of concurrent infection was equally negative on the Packed Cell Volume of cattle but this effect seems to be caused by trypanosome alone following the practice of drenching by pastoralists.

Key words: Cattle production, helminths, trypanosomes, body condition score (BCS), packed cell volume (PCV), extensive management system, Sudano Sahelian Region, Cameroon.

INTRODUCTION

Most of the sub-Saharan African range lands are inhabited by pastoralists and agro-pastoralists and many of whom live on the edge of disaster and amidst poverty (Teer, 1986). They are at the mercy of vector borne diseases, predators, drought, floods and other natural disasters (Otim et al., 2004). In Cameroon, especially in

areas where traditional farming is practiced, cattle play an important role in providing protein (meat, milk) and non-food commodities (manure, hides). They also serve as a form of saving for the rural population. Consequently, the number of animals owned appears to be more important than their individual productivity. One of the major

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constraints for cattle breeding in tsetseinfested areas is trypanosomiasis, of which anaemia is a predominant sign (Kaufmann et al., 1992). High worm burdens, predominantly *Haemonchus contortus*, *Bunostomum phlebotomum* and *Oesophagostomum radiatum* have also been reported to induce severe anaemia, emaciation and hypoproteinemia (Kaufmann and Pfister, 1990). Although single parasitic infections in a host are common in nature, mixed infections with various species or with several different types of parasites is the rule (Sharma et al., 2000). In mixed infections, the interaction between two or more parasites may lead to significant physiological and biochemical changes in tissues and fluids, which cannot be attributed to either of these parasites individually (Sharma et al., 2000). Infections of trypanosomes cause immunosuppression resulting into flare up of other bacterial or viral infection and poor immune response to vaccines (Gupta et al., 2009; Singla et al., 2009).

Under experimental conditions, concurrent infections of *Trypanosoma congolense* and *H. contortus* resulted in more severe disease in Djallonke sheep (Goossens et al., 1997) and in N'dama calves (Kaufmann et al., 1992) than single infections. The prevalence of trypanosomiasis as well as that of helminthiasis in cattle has been described in Cameroon by many authors (Mpouam et al., 2011; Ntonifor et al., 2013); but little is known about the prevalence of concurrent infections in naturally grazing cattle whose occurrence was alluded in the south west by Ngole et al. (2003) who analyzed the blood and feces of cattle, originating from the savanna and sahel regions and, destined for slaughter. The present study was undertaken in a peri-domestic Sudano-Sahelian agro-eco-system in Cameroon to determine the prevalence of these infections among cattle and assess their impact on two indicators of cattle health.

MATERIALS AND METHODS

Study area

The survey was carried out in Yoko village in the Sudano Sahelian agro-ecological zone in Cameroon at the beginning of the rainy season (June, 2013). The study site is 124 km from Ngaoundéré, the regional capital of the high Guinea savannah zone which is the main access way from Yaoundé, the political capital of Cameroon. In the Sudano Sahelian zone, the wet and humid season lasts for 7 months from June to the end of September; the highest rainfall is concentrated around July and August. Many animals are reared in Yoko, the most important being cattle, sheep and goats; animal husbandry is practiced mostly by Mbororo and Fulbe tribes for centuries (Bronsvort et al., 2002) and have remained subsistence oriented. During the rainy season in Yoko, an important portion of the land is used for agricultural activities thus limiting pasture for livestock; whereas during the dry season a large amount of pasture resulting from dry millet, maize and sorghum cobs is available and attracts many transhumant pastoralists in the zone. The study site comprised of 10 adjacent villages situated at about 1.5 km apart and is surrounded by fields in an area of open Savannah woodland and fresh water swamps and artificial water catches.

Animals and sampling

Pastoralists of Yoko and of the surrounding villages were convened in a meeting and sensitized on the purpose of the project. There were 20 pastoralists in total and all of them received a short questionnaire to sample the perception of the importance of both trypanosomiasis and helminthic infections in their herds as well as their responses to the issue. Five pastoralists, owners of a total of 24 herds, were selected randomly from group; their oral consent for participating in the study was subsequently obtained. The size of herds varied between 50 and 70 animals. Each animal was attributed a number marked on its skin; the list of cattle for each herd was then constituted and between 8 and 10 animals were randomly selected from each list. Characteristics of each animal notably sex, age (determined from dentition), breed, color of the skin and the body condition score (BCS) (determined according to Ezanno et al. (2003) were recorded.

The age of animals and the body condition score (BCS) were then categorized into three groups: calf (0 to 6 months), juvenile (6 to 24 months) and adult (older than 24 months) for age and poor (≤ 3), good (> 3 and $7 <$) and very good (> 7). All animals had venous blood samples collected from the ear vein into microhaematocrit tubes. Faecal samples were collected per rectum from each animal using a plastic glove then put into clearly labeled plastic bags and transported in a cool box to the laboratory where they were stored in a refrigerator until examination the following day.

Diagnosis

Blood samples collected into microhaematocrit tubes were centrifuged at 8000 rpm for 5 min. The percentage packed cell volume (PCV) was then read with the help of a Hawksley microhaematocrit reader (Hawksley, Lancing, United Kingdom). Trypanosome infections were diagnosed using the buffy coat technique (BCT) (Murray et al., 1977) while the number of trypanosomes was calculated by the method of Herbert and Lumsden (1976). Trypanosomes species were identified by their movement, size and morphology and confirmed later with a stained blood smear stained with Giemsa. All animals infected by trypanosomes were immediately treated with a trypanocidal drug Veriben B12[®] (Ceva, France) at curative dose of 7 mg/kg body weight. Faecal samples were processed following the technique described by Behnke et al. (2006) to determine helminthic infections and egg counts.

Data analysis

The data were entered in microsoft office excel. Prevalence was calculated as a percentage of d/n where d is the number of animals infected and n the total number of animals examined. The mean fecal egg counts were calculated with respect to age category, and sex. The Chi-square test (χ^2) and Z test were used to compare proportions; the t-test, were used to compare means. The XLSTAT 2014 was used to perform all the analysis. Level of precision was held at 95%, and $P \leq 0.05$ set for significance.

RESULTS

Pastoralists' knowledge and practices

All interviewers (20) knew about trypanosomiasis and helminthiasis and they regularly use trypanocide and anti-helminthic medicines to treat sick animals. These medicine

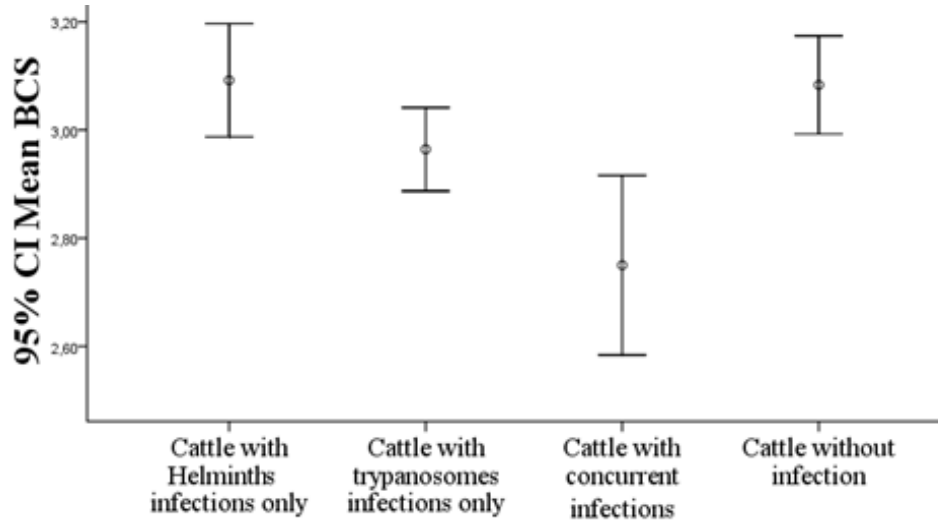


Figure 1. Effect of trypanosomes, helminths and concurrent infections on cattle's BCS.

medicines are equally administered as preventive measures.

Characteristic of cattle sampled

Two hundred and twenty three (223) cattle were sampled from the 24 herds selected for the survey. The Gudali (*Bostaurus taurus*) was the main breed; cattle were of three colors: Black, white and brown; the most represented color was brown 57.84% ($X^2 = 148.735$; $P < 0.0001$). There were more females (53.81%) than males (46.18%) ($Z = 1.138$; $P = 0.255$). Concerning age category, adult cattle were the most represented (72.64%), followed by juvenile (26.46%) and calves (0.9%). The mean body condition score was 3.067 (SD = 0.301). The majority of cattle (80.72%) ($Z = 9.174$; $P < 0.0001$) fell within the poor score of BCS (2.881; SD = 0.188); animals with a good BCS had a mean of 3.843 (SD = 0.227).

Trypanosomes and helminth infections

Of the 223 cattle sampled, 75 were infected with helminths, corresponding to a prevalence of 33.62% (95% CI, 27.43 to 39.83%) whereas 22 (9.86%; 95% CI, 5.95 to 13.78%) were infected with trypanosomes; seven animals had concurrent infections. Two types of helminth eggs strongyles, *toxocara* and eimerian coccidian oocysts were identified. Strongyles were the most prevalent of the helminths species identified (96.30%) ($X^2 = 244.856$; $P < 0.0001$); the two others *toxocara* and *eimeria* had 2.47 and 1.23% prevalence, respectively; the mean egg per gram was 155.147 (SD = 125.670 EPG) corresponding to light infection. Of the 75 helminthic

infections, 70 (93.33%) were single infections while 5 (6.67%) were multiple infections. The mean egg count was 155.147 (SD = 215.126) and 278.571 (SD = 372.891), respectively in cattle infected with helminths only and concurrent infections; the difference between these means was not significant ($t = -1.339$; $P = 0.185$). Three species of trypanosome were identified in this study; *T. congolense*, *T. vivax* and *T. brucei*. Like helminths, trypanosome infections are dominated by one species: *T. congolense* (81.82%; 95% CI, 65.70 to 97.94%); the two other species: *T. vivax* and *T. brucei* represented, respectively 13.63 and 4.54% of all infections. The prevalence of helminthic infections did not vary significantly between the sex ($Z = -0.669$; $P = 0.503$) and the age ($Z = -0.472$; $P = 0.638$) categories. As concerns trypanosome infections, a significant difference was observed only for age category and notably between adult animals (22/162) and those aged at most 2 years (0/61) ($Z = 2.831$; $P = 0.004$).

Impact of helminths and trypanosomes infections on cattle: BCS and PCV

The mean BCS among cattle infected with helminthic infections only (68) stood at 3.092 (SD = 0.432) and 80.88% of these animals had a poor BCS. The mean BCS among those infected exclusively by trypanosome (15) was 2.964 (0.134); 93.33% of the latter had a poor BCS. There was no significant difference between these two means of BCS ($t = -1.091$; $P = 0.279$). However, a significant difference was obtained when comparing the mean BCS between cattle with either trypanosomes ($t = 3.118$; $P = 0.006$) or helminths ($t = 4.114$; $P = 0.001$) infections and those with concurrent infections (Mean BCS: 2.750; SD = 0.158) (Figure1).

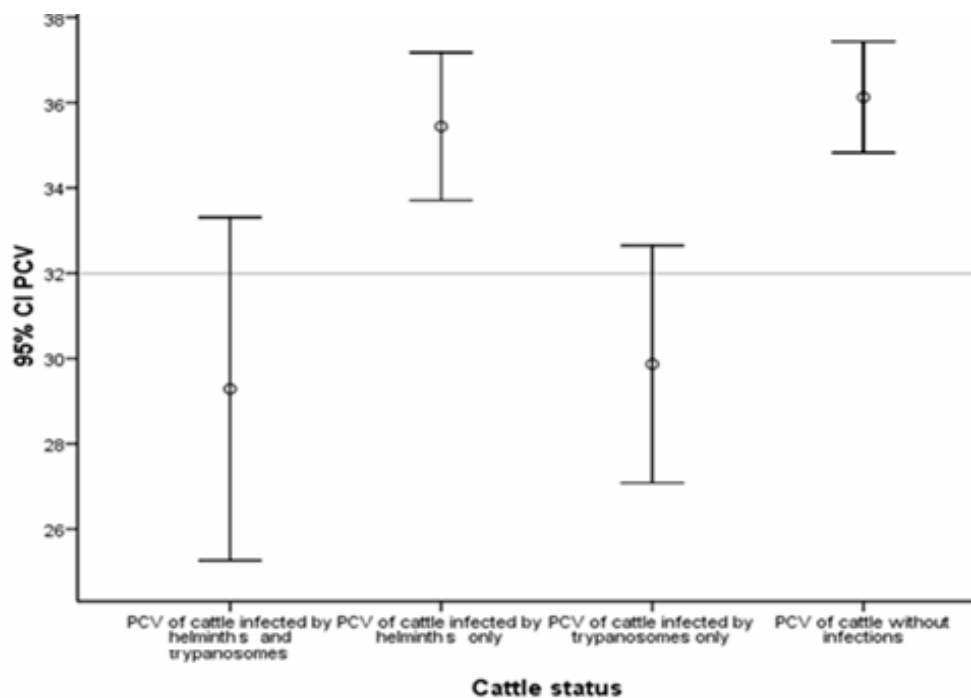


Figure 2. The effect of trypanosomes, helminthes and concurrent infections on cattle PCV.

The mean PCV among cattle infected by helminths only was 35.441 (SD = 7.154); the latter did not vary significantly with that of cattle free of infections (Mean 36.143; SD = 0.653) ($t = -0.635$; $P = 0.526$). In cattle infected with trypanosomes only, the mean PCV was 29.867 (SD = 5.027); this value was significantly lower than that observed among cattle free of infections ($t = -3.143$; $P = 0.002$) and that observed among cattle infected by helminths ($t = -2.860$; $P = 0.005$). The PCV of cattle with concurrent infections was 29.286 (SD = 3.469); this value was significantly lower than those observed for cattle free of infections ($t = -2.382$; $P = 0.019$) or for cattle infected by helminthes ($t = -2.226$; $P = 0.029$). No significant difference was found between the mean PCV of cattle infected by trypanosomes and those with concurrent infections ($t = -0.263$; 0.796) (Figure 2).

DISCUSSION

Helminth infections are ubiquitous and represent, with trypanosomes, a serious constraint to efficient livestock productivity in Africa (Ndamukong, 1985; Vlassoff and Leathwick, 2001; Nganga et al., 2004). In this study we have evaluated the prevalence of these parasitic diseases and compared their impact on two indicators of cattle health in the Mayo Rey Division. The overall prevalence of helminth infections among sampled cattle was 33.62% (95% CI, 27.43 to 39.83%). This frequency

was lower than findings from (Moti et al., 2013) in Ethiopia and (Achi et al., 2003) in Ivory Coast. However, it was in line with that of Ntonifor et al. (2013) in the north west region. This low prevalence might be due to the frequent drenching behavior of herders. Strongyles were the predominant helminthes. Similar observations were made by other authors (Cheru et al., 2013; Moti et al., 2013). The prevalence of infections was not significantly different between age and sex categories. These results corroborate those of Moti et al. (2013) and Ntonifor et al. (2013), suggesting that cattle of all ages and sex are exposed to equal risk of infestation.

The prevalence of trypanosomiasis in the study zone was 9.86% (95% CI, 5.95 to 13.78%) and it was mainly caused by *T. congolense* (81.82%). The high abundance of *T. congolense* among infected cattle is in accordance with observations made by (Ndamkou and Nchare, 1995) in tsetse infested areas of the north region. Thus, it suggests that transmission of this disease is mainly achieved by the biological vectors, tsetse flies. The prevalence of bovine trypanosomiasis did not vary significantly between sexes. These results are in consonance with reports from (Sam-Wobo et al., 2010) and confirm the fact that neither the biological nor the mechanical vectors (like tabanids) discriminate host sex in their search for blood meal. The age-specific rates of bovine trypanosomiasis showed no significant difference as reported by (Delafosse et al., 2006; Yeshitila et al., 2006). However findings of other authors like (Sam-Wobo

et al., 2010) are opposed to that. These authors found a significantly higher prevalence of trypanosomiasis among older cattle; they explained this situation with the grazing habit of older cattle being exposed to insect bites than the young calves which always remain in their byres (herd shed).

The mean BCS of sampled cattle was 3.067 (SD = 0.301) and the majority of them had a poor score; this poor condition of most sampled animals could be attributable to the climatic conditions. Deffo et al. (2010) have reported that the performance of animals in the north of Cameroon decreases in the dry season; animals of the study zone may have not considerably recovered from the stress of dry season (temperature, limited forage) by the time the study was undertaken. Cattle infected by either trypanosomes or helminths had a mean BCS significantly higher than that of those with concurrent infections. Both infections have a negative effect on the body condition of cattle but their effect on cattle BCS is significantly higher when present concomitantly; similar observations were made by Dwinger et al. (1994) in the Gambia.

Trypanosomes like gastro-intestinal parasites are known to cause anemia (Morrison et al., 1981), measured by the packed cell volume (PCV). In this study, the PCV was significantly lower among trypanosome infected animals than in non-infected animals. Our results indicate trypanosomiasis involvement in reducing the PCV values in infected animals. Anemia is a well-recognized and inevitable consequence of trypanosomiasis and gastrointestinal parasites (Morrison et al., 1981). Contrary to observations made by Agyemang et al. (1997) on N'Dama cattle in Gambia, the effect of helminth infections on PCV was not significant in this study. The significant effect of the concurrent infections on PCV seems to be caused by trypanosomes alone. To explain this situation, we suggest two reasons. The first reason is that cattle of the study sites may have developed tolerance to helminthes more than trypanosomes. The second reason highlights the impact of drenching practiced by pastoralists. This practice may have resulted in low EPG among infected animals, leading to lesser effect of these parasites on anemia.

Conclusion

Trypanosome and helminth infections are prevalent in cattle in Mayo Rey Division; helminth infections are more abundant. Both infections have a negative effect on cattle health indicators.

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Conflict of interest

Authors have none to declare.

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Full Length Research Paper

Prevalence of endoparasitic helminths of donkeys in and around Haramaya district, Eastern Ethiopia

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A cross sectional study was conducted to determine the prevalence of endoparasites of donkeys in and around Haramaya district, East Hararghe zone of Oromia regional state. Coprological examination was carried out on fecal samples collected from 384 donkeys. Simple flotation, sedimentation and fecal culture techniques were used for the detection of eggs and larvae of helminth parasites. The overall prevalence of endoparasitic infection was 93.75% (n=360). Four species of helminths: *Parascaris equorum* (20.5%), *Fasciola species* (15.36%), *Oxyuris equi* (15.36%) and *Dictyocaulus arnfieldi* (21.88%) and two genera (*Strongylus* and *Trichonema*), were encountered. Identification of L₃ of nematodes from coprocultured faeces of donkeys showed the predominance of *strongyles species* (65%), *Dictyocaulus Arnfieldi* (25%), and *Oxyuris equi* (10%). The high prevalence of helminth parasites noted in this study calls for regular monitoring and intervention measures such as strategic deworming of donkeys.

Key words: Endoparasitic helminths, Haramaya district, prevalence.

INTRODUCTION

Ethiopia claimed to have the largest livestock population in Africa, with an estimated population of 47.5 million cattle, 26.1 million sheep, 21.7 million goat, 7.8 million equines out of which 5.42 million are donkeys, 1 million camel and 39.6 million chickens (CSA, 2009). These include rampant animal diseases, poor nutrition, poor husbandry, poor infrastructure, and shortage of trained man power and lack of government policies (PACE-Ethiopia, 2003). Among the livestock, donkeys are tolerant to hot, arid environments where the agriculture is subsistence and are popular among pastoralists. It has been suggested that donkeys can comfortably pull more weight than they can carry provided that the harness is

suitable (Saul et al., 1997), but their health aspect have been ignored (Taylor et al., 2007).

Parasitic helminthes are one of the most common factors that constrain the health and working performance of donkeys worldwide (Zerihun et al., 2011). Some of them are active bloodsuckers and cause various degrees of damage depending on the species and numbers present, nutritional and the immune status of equids. Though, the available information suggests that gastro-intestinal helminthes are the main reason for early demises of donkey (Zerihun et al., 2011). There are more than 150 species of helminth parasites that can infect donkeys. The most common and troublesome are: large

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strongyles, small strongyles, roundworms, tapeworms, lungworm, pinworms, threadworms and bots. Probably the most important in terms of health risk are the large and small strongyles, roundworms and tapeworms (Radostits et al., 2007).

Some works have been done in different parts of the country such as: Endoparasites of donkeys in Sululta and Gefersa Districts by Zerihun et al. (2011), strongyles and parascaris parasites population in working donkeys of Central Shoa by Ayele and Dinka (2010), occurrence of lungworm infection in equine, and their risk factors in and around Jimma town by Tihitna et al. (2012) and prevalence of gastro-intestinal parasites of donkeys in Dugda Bora District by Ayele et al. (2006). However, there has not been any study conducted in the study area. Therefore, the objectives of the study were: to determine the prevalence of helminth parasites of donkeys in and around Haramaya District, and to identify species of gastro-intestinal helminthes recovered from selected samples.

MATERIALS AND METHODS

Description of study area

The study was conducted in and around Haramaya district, eastern Hararghe zone, Oromia regional state, Ethiopia. It is located about 507 kms away from Addis Ababa to east and 14 kms west of Harar town. The altitude of the district ranges from 1400 to 2340 m.a.s.l. Geographically, the area is located at 41°59'58" N latitude and 09°24'10" E longitudes. It receives an annual rain fall approximately 900 mm and climatically the district has two ecological zones of which 66% mid land and 33.3% low land (CSA, 2009).

Study animals

The study was conducted on donkeys that came to the different markets in and around the Haramaya district. Donkeys of different age, sex and body condition score were tried to be included in the study. The body condition score was done according to Henneke (1983).

Study design

A Cross-sectional study was conducted to determine the prevalence of gastrointestinal helminth parasites of donkeys in the study areas.

Sampling method and sample size determination

By using simple random sampling methods and 95% confidence interval, the sample size was calculated using the formula of Thursfield (2005).

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

Where; n = required sample size,
P_{exp} = expected prevalence,

d = required precision (usually 0.05).

By using an expected prevalence of 50%, a total 384 donkeys were included in the study.

Study methodology

Coprological examination

The fecal samples were collected directly from the rectum of the donkeys by using rectal gloves or from freshly passed droppings. Each sample was labeled with animal identification, owner's name, date and area of collection with indelible pen. After collecting, the sample was transported to Haramaya University parasitology laboratory for immediate processing and examination of the sample. The observation of helminth parasites eggs in the faeces of the donkeys was evaluated by using the coprological flotation and sedimentation techniques (MAFF, 1979).

Fecal culture

Fecal culture was done for 65 positive fecal samples according to Bowman (2003) to appreciate the gastrointestinal helminthes parasites larvae profile. Identification of larvae (L₃) was based on the shape and gut cells, relative size of sheath tail and shape of tail of larvae (Zerihun et al., 2011).

Data management and analysis

The datas were entered into Microsoft excel 2007 spread sheets and were analyzed using STATA (version 11) statistical software package. The association of infection with the different variables was analyzed using χ^2 test. A statistically significant association between variables is considered to exist if the calculated p-value was less than 0.05 with 95% confidence level.

RESULTS

From the total of 384 donkeys, 360 were infected with an overall prevalence of 93.75% (Table 1). The prevalence of helminthes parasites in the study area showed that *Strongyle species* were with higher prevalence (84.89%) followed by *Trichonema species* (23.44%), *D. arnfieldi* (21.88%), *P. equorum* (20.5%), *F. hepatica* and *O. equi* with 15.36% each.

DISCUSSION

The result indicated that donkeys are a host to different species and genera of helminth parasites. The prevalence of strongyles disagrees with the result of 99.5% by Zerihun et al. (2009), a 100% report by Alemayehu (1995), 96.77% by Sinasi (2009), 92% by Ayele and Dinka (2010), and 65.1% by Hussien (2011). This may be due to the differences in the agro-ecological and climatic conditions between the study areas. The prevalence of *Trichonema species* (23.44%) in the study was higher than the 15.85% reported by Shrikhande et al.

Table 1. Prevalence of helminth parasites by month, sex, age and body condition of the animals in the study sites along with their statistical significance.

parameter	Variables	Animals examined	No. of positive	Prevalence (%)	χ^2	p-value
Month	December	55	52	94.55	0.2488	0.969
	January	184	173	94.02		
	February	120	112	93.33		
	March	25	23	92.0		
	Total	384	360	93.75		
Sex	Female	120	113	94.17	0.0517	0.820
	Male	264	247	93.56		
	Total	384	360	93.75		
Age	Young	65	59	90.77	1.1865	0.276
	Adult	319	301	94.36		
	Total	384	360	93.75		
Body condition	Poor	163	157	96.32	25.28	0.00
	Fair	156	151	96.79		
	Good	65	52	80.0		
	Total	384	360	93.75		

(2009). This may be due to the management system and nature of the grazing area. The current prevalence of *D. arnfieldi* (21.88%) in the study area was greater than the reports of 9.67% by Sinasi (2009), 3.65% of Shrikhande et al. (2009) and 13.8% by Tihtina et al. (2012). This difference could be due to the difference in environmental conditions and management practice favoring the survival of the larvae of the parasite.

The prevalence of *P. equorum* (20.5%) recorded in this study, was higher than the previous report of 17.3% by Fikru et al. (2005) but less than the results of 29.26% by Shrikhande et al. (2009), 43% reported by Ayele et al. (2006) and 22.58% reported by Sinasi (2009). This may be due to the agro-ecological and climatic difference of the study areas and lack of awareness about the health animals. The prevalence of *O. equi* was higher than the 8.53% report by Shrikhande et al. (2009) and 6.4% reported by Sinasi (2009). This may be due to the climatic difference between the study areas and the management systems. The prevalence for *F. hepatica* was higher than the previous report of 1.5% by Ayele et al. (2006) in Dugda Bora district. This higher prevalence suggests that *F. hepatica* is common in highlands where donkeys share the same grazing area with ruminants that are considered as primary host of liver fluke and favorable ecological conditions which allow multiplication and spread of intermediate snail host in the district.

The higher prevalence in adult donkeys in the study disagrees with the result of Zerihun et al. (2011). This may be due to high risk of getting infection from the market and other work areas. In Haramaya district the seasonal differences between months have no a great

effect on the prevalence of equine helminth parasites. This may be due to the presence of almost similar climatic condition between the months and because of the permanent marshy grazing field in the study area. This result disagreed with the reports of Hussen (2011). This may be due to agro-ecological and climatic difference between the study areas. There was a significant difference in helminth prevalence on the basis of body condition score which was in agreement with previous reports by Matthee et al. (2002), Getachew et al. (2009) and Brady and Nichols (2009).

Conclusion

The study revealed a high prevalence of a wide range of species of gastro-intestinal helminths parasites that play a great role in confronting the health and welfare of donkeys in and around Haramaya district. The result also suggests the presence of favorable environmental condition for the survival, infection and perpetuation of helminthes of donkey in the district.

Conflicts of interest

The authors declare that they have no conflicts of interest.

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Full Length Research Paper

Susceptibility pattern of aerobic bacteria isolated from septicemic cattle in Adama, Ethiopia

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From November, 2011 to March, 2012 a total of 586 cattle were examined for febrile conditions. From these animals, 62 (10.6) animals were found to be febrile. So the study was conducted on these animals with the objective of identifying and carrying out antibacterial susceptibility testing on the isolates. From the total of 62 blood cultures processed, only 37 cultures gave bacteria while the remaining 25 cultures were discarded because of absence of visible bacterial growth. From the total isolates, *Staphylococcus aureus* were predominant by accounting 11 (29.7%) of the total isolate followed by other *Staphylococcus* species and *Pasteurella multocida* which constitutes 21.6 and 18.9% of the total population, respectively. On the other hand *Salmonella* and *Streptococcus* species were also isolated in considerable amount being encountered in 16.2 and 13.6% of the total organisms, respectively. Furthermore, antibacterial sensitivity test was performed on the isolates by the discs amoxicillin, ampicillin, gentamicin penicillin-G, chloramphenicol, oxy tetracycline polymyxine B, streptomycin and ciprofloxacin. From these drugs chloramphenicol was the most effective drug being active on most of the isolates. This drug was effective on 97.3% of the total isolates followed by ciprofloxacin, gentamicin, and ampicillin were effective on 89.2, 83.8 and 81.1% of the isolates, respectively.

Key words: Adama, cattle, septicaemia, febrile, *Staphylococcus* susceptibility test.

INTRODUCTION

Septicaemia is a condition in which toxic bacteria invade the bloodstream. It is very serious because the organisms and their toxins produced become widely distributed throughout the tissues, and every organ is affected by them (Edward, 2005). Bacteraemia is different from septicaemia in that bacteraemia is not accompanied by sepsis or septic shock. The difference between septicaemia and bacteraemia is of one degree. In bacteraemia, bacteria are present in the bloodstream for only transitory periods and do not produce clinical signs; for example, a clinically unimportant bacteraemia probably occurs frequently after rectal examination or other manipulations in which mucosa are disturbed. In

septicaemia, the pathogen is present throughout the course of the disease and is directly responsible for initiation of the disease process (Radostitis et al., 2010).

Resistance to antimicrobial agents has resulted in morbidity and mortality from treatment failures and increased health care costs. Although defining the precise public health risk and estimating the increase in costs is not a simple undertaking, there is little doubt that emergent antibiotic resistance is a serious global problem. With the introduction of a variety of antimicrobials, it became necessary to perform the antimicrobial susceptibility test as a routine (Lalitha, 2004).

In developing countries, like Ethiopia, there is no enough

data on what type of micro-organisms causing septicaemia and which regime of antimicrobials should be recommended for each type of microbes. The aim of this study was to detect bacterial pathogen responsible for septicaemia in bovine species in Adama area and determination of their antibiotic response.

MATERIALS AND METHODS

Description of the study area

This study was conducted in Adama. Adama city is located in Oromia National Regional State, East Shewa Zone at a distance of 100 km from Addis Ababa. Its geographical location is 8° 44' North Latitude and 39° 04' East Longitude.

Study animals

The study was conducted on bovine species of all age groups that come to adama animal health clinic from different areas of Adama and its surroundings.

Study design

A purposive sampling was used during the study period conducted from November, 2011 to March, 2012 by collecting data on events associated with septicaemia in bovines that come to adama open-air veterinary clinic. Clinically sick animals were considered as positive for septicaemia based on rise in body temperature and general febrile conditions purposively.

Sample size determination

The sample size for the study was determined by Thrushfield (1995), taking into account 95% confidence interval, desired accuracy level of 5 and 50% expected prevalence of septicaemia in bovine species. Eventhough by this formula 384 animals were enough, the sample size was increased to 586 in order to increase its accuracy.

Sample collection

Clinically septicemic animals were identified by clinical signs of septicaemia primarily by measuring whether there is rise in body temperature or not. In addition to this, animals were clinically examined for the presence of general depression, shivering, rapid breathing (tachypnoea) or rapid heart rate (tachycardia). Blood sample was collected from clinically sick animals by using heparinised tube aseptically. The collected blood sample was immediately transported for further bacteriological and biochemical tests to Addis Ababa university microbiology laboratory found in Debrezeit.

Cultural procedures

Isolation and identification of bacterial species from collected blood sample were conducted according to standard methods recommended by Quinn et al. (1994). Blood samples collected from cattle were brought to microbiology laboratory and they were enriched in brain heart infusion in order to follow if there is a possible bacterial growth. They were incubated for a maximum of

one week and checked every 24 h for any visible change indicative of bacterial growth. If there was a sign of turbidity the sample was further propagated to blood and MacConkey agar. The growth of typical colonies on blood agar, and MacConkey agar was characterized. On blood agar, the presence or absence of haemolysis, the types of haemolysis and general appearance of the colonies (colour, shape, size, consistency etc.) were examined. On MacConkey agar, the colonies were examined for the presence or absence of growth; general appearance and ability to ferment lactose were recorded. To get a single purified and isolated colony, each colony having a unique character on primary culture media was taken and subculture on nutrient agar. Further identification of bacterial isolates to the species level was made by conducting appropriate biochemical test based on the genera of bacteria isolated on primary tests.

Further species identification and differentiation of *Staphylococcus* was made by colonial morphology from gram stain smear, catalase test, tube coagulation test using rabbit plasma, growth and fermentation on Mannitol salt agar. On the other hand, *streptococcal* identification and differentiation was made at genus level by colonial morphology on blood agar, gram stain catalase test, and OF tests. Gram negative bacteria were differentiated by Gram stain, Giemsa stain colonial morphology and fermentation on MacConkey agar, motility test, indole, Citrate utilization test, MR-VP test Triple sugar iron agar, and carbohydrate fermentation and hydrogen sulphide gas production tests.

Antimicrobial sensitivity test

The Kirby-Bauer Plate agar disc diffusion method was used to test *in vitro* antimicrobial sensitivity test of each isolated species of bacterial pathogens. For most bacterial pathogens Mueller Hinton agar medium was used except *streptococcus* for which 7 to 10% sheep whole blood was added to Mueller Hinton agar. The depth of the test medium in 90 mm petridish was nearly 4 mm, which obtained by pouring 25 to 30 ml of prepared medium. All procedures were performed according to (CLSI, 2012).

Data analysis and management

Data collected was managed and prepared on Microsoft Excel Sheet, coded and analyzed using IBM SPSS19 software. Descriptive statistics and chi-square test were used for analysis. Statistical significance for association was checked at $p \geq 0.05$.

RESULTS

Bacteriological examination

In this study a total of 586 animals were examined for septicaemia during the study period (from November 2011 to March 2012). From these animals only 62 (10.6%) were found to be septicemic, hence only 62 blood samples were taken for bacteriological examination. Among these samples cultured, only 37 cultures gave bacterial results while others discarded because of absence of visible bacterial growth on brain heart infusion. The isolated bacteria were 24 gram positive and 13 gram negatives. All the bacterial belong to four genera namely, *Staphylococcus* species, *Streptococcus* species *Pasteurella* spp. and *Salmonella*

Table 1. The distribution of septicaemia with age, breed and sex.

Parameter		Positive for bacteria	Negative for bacteria	Total
Breed	Local	29 (46.8)	16 (25.8)	45 (72.5)
	Cross	8 (12.9)	9 (14.5)	17 (27.4)
	Total	37 (59.7)	25 (40.3)	62 (100)
Age	Adult	22 (35.5)	15 (24.2)	37 (59.7)
	Young	15 (24.2)	10 (16.1)	25 (40.3)
	Total	37 (59.7)	25 (40.3)	62 (100)
Sex	Male	21 (33.8)	17 (27.4)	38 (61.3)
	Female	16 (25.9)	8 (12.9)	24 (38.7)
	Total	37 (59.7)	25 (40.3)	62 (100)

spp. The frequency of the isolates was as follows; *Staphylococcus aureus* 11 (29.7%), other *Staphylococcus* species 8 (21.6%), *Pasteurella multocida* 7(18.9%), *Salmonella* species 6(16.2%) and *Streptococcus* species 5 (13.6%) (Table 1). Among the isolates *Staphylococcus aureus* isolates predominate by accounting 29.7% of all the isolates followed by *Staphylococcus* species. These species were 21.6% of all the isolates. The other species isolated were *Pasteurella multocida*, *Salmonella* species and *Streptococcus* species which account 18.9, 16.2 and 13.6%, respectively.

Sensitivity test result

In this study *S. aureus* showed 100% susceptibility to chloramphenicol, followed by gentamicin and ciprofloxacin which had 90.9% efficacy on these isolates. *S. aureus* species found to be highly resistant to penicillin G with the finding of 0% susceptible organism. In addition these organisms were less susceptible to the routinely used drug, oxy tetracycline with susceptibility result of 63.6%. *Staphylococcus* species other than *Staphylococcus aureus* showed a great susceptibility to most of the drugs used. Ampicillin, streptomycin, Chloramphenicol, erythromycin and polymixine B were 100% effective on these isolates. Oxy tetracycline and penicillin G showed relatively the lower result by accounting 75% efficacy. On the other hand *P. multocida* were fully susceptible to penicillin G, streptomycin and ciprofloxacin followed by Chloramphenicol Erythromycin, ampicillin and gentamicin with susceptibility pattern of 85, 85.5, 57.1, and 57.1%, respectively.

Furthermore, *Salmonella* species showed a high degree of susceptibility to Chloramphenicol and ciprofloxacin by 100%. These organisms were resistant to penicillin-G and to oxy tetracycline. *Streptococcus* species were fully susceptible to all drugs used except ciprofloxacin and oxy tetracycline with susceptibility

pattern of 80 and 60%, respectively. From all tested drugs chloramphenicol showed the highest activity on all isolates being effective on 97.3% of the isolates followed by ciprofloxacin, gentamicin, and ampicillin were effective on 89.2, 83.8 and 81.1% of the isolates, respectively. From all drugs used penicillin showed the least result by accounting an overall effectiveness of 48.6%.

DISCUSSION

This study showed that high rate of positive case of bacteria with fever indicative of septicaemia (59.7%) which was reported to be higher side than Shiferaw et al. (2009) who reported 20.6% of isolation rate in Debrezeit. This difference may come from the time elapse and agro ecological difference between the two studies. This study finding agrees with the work of (Demissie, 2011) who reported 60% isolation rate of bacteria from septicemic cattle in Sebeta Veterinary Clinic. Septicaemia is a disease complex that have various etiologist. That is why all septicemic animals were not positive for bacteria. Other septicemic conditions may rise from infectious agents other than bacteria, Radostitis et al. (2010) discussed that viruses, fungus and some protozoa can cause septicaemia. The isolated bacteria belong to four genera, namely *Staphylococcus* which accounts for 51.3%, *Pasteurella* 18.9%, *Salmonella* (16.2%) and *Streptococcus* species (13.6%). Among the isolates, *Staphylococcus* species were found to be the leading cause of septicaemia which agrees with the finding of (Demissie, 2011). *S. aureus* was found to be predominant in the study population. This may be due to wide spread of thorny plants like acacia in the study area which can causes skin damage for entrance of organisms to the circulatory system. The second most dominant isolate was found to be *Pasteurella multocida* this account for 18.9% of the total isolates which is supported by the work of (Demissie, 2011). This bacterium is mostly associated with stress causing agents like over working

and poor body conditions, animals in this study area are subjected to hard work and they are in poor body condition hence, highly significant in causing septicaemia this idea is supported by (Rodestitis et al., 2010). Rodestitis et al. (2010) also discussed that pasteurellosis is mostly significant in young aged from 6 months to 2 years old. The other isolates were found to be *Salmonella* species and *Streptococcus* species which accounts for 16.2 and 13.5%, respectively. Even though *in vitro* susceptibility pattern does not ideally represent the real treatment, it is mandatory to perform sensitivity test before prescribing drug regime. In this particular study, isolated bacteria were subjected to *in vitro* susceptibility test by referring all the recommend routine procedures (CLSI, 2012).

From all tested drugs, chloramphenicol showed the highest activity on all isolates being effective on 97.3% of the isolates because the drug have wide spectrum activity on both gram negative and gram positive bacteria. The findings were supported by (Quinn et al., 1994) who discussed the effectiveness of the drug to various microorganisms including chlamydia and rekettsia. Numerically this drug was 100% effective on *Staphylococcus* species, *Salmonella* and *Streptococcus* species and 85.5% effective on *P. multocida* species. Following chloramphenicol, other drugs also showed relatively a high degree of effectiveness on the isolates. Ciprofloxacin, gentamicin, and ampicillin were effective on 89.2, 83.8, and 81.1% of the isolates, respectively. In this particular study, the potential drug penicillin G showed the least efficacy on the bacterial isolates. This may come from the fact that most predominant isolates were *S. aureus* (29.7%) which are resistant to penicillin because of their penicillinase activity. This idea is supported by (Quinn et al., 1994). On the other hand, *Salmonella* species which constitutes 16.6% of all the isolates were also resistant to penicillin.

Robert (2006) discussed that in some gram negative bacteria plasmid mediated resistance is common because their enzymes are constitutively expressed and cause high level of resistance. Eventhough penicillin was found to be less effective on these organisms it showed great deal of effectiveness on *P. multocida*, *Streptococcus* species and other *Staphylococcus* species 100, 100, 75%, respectively. On the other hand, the most widely used drug, oxytetracycline have showed potential that was indicative that organisms are getting resistant to these drugs. This may be due to extensive use of the drug for all febrile cases in the study area. Generally oxytetracycline was effective on 85.5% of *P. multocida*, 75% of other *Staphylococcus* species, 63.6% of *S. aureus* 60% of *Streptococcus* species and 0% of *Salmonella* species. Among all the isolates streptococcus species showed a high degree of susceptibility to all drugs used. Numerically, 100% susceptibility to ampicillin streptomycin, gentamicin, chloramphenicol penicillin G and ciprofloxacin; 80% to polymixine B and 60% to oxytetracycline.

CONCLUSION AND RECOMMENDATIONS

The study showed that bacterial cause of septicaemia is highly prevalent in the study area. From the total animals examined 59.7% septicemic cases were due to bacteria. *S. aureus* followed by other *Staphylococcus* species and *P. multocida* were dominant which constitutes 29.7, 21.6 and 18.9%, respectively. Moreover *Salmonella* and *Streptococcus* species were also predominant in considerable amount with 16.2 and 13.6% of the total organisms, respectively. The anti-bacterial sensitivity test result revealed that, chloramphenicol was the most effective drug on much of the isolates. Based on the conclusion, the following recommendations are forwarded:

1. Chloramphenicol is the best drug for treating bacterial cause of septicaemia.
2. Some organisms are getting resistance to the routinely used drug oxytetracycline. Therefore administering this drug for every febrile case has to be reviewed in every veterinary clinic.
3. Since there is no full information concerning bacterial and other cause of septicaemia in Ethiopia, it is better to conduct researches on this area. National and Regional laboratories have to think over it.

Conflict of interest

Author has none to declare.

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Full Length Research Paper

Caprine Coccidiosis: An outbreak in the Green Mountain in Libya

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This study involved a herd consisting of 200 goats in Green Mountain area, suffering from decrease in weight gain, bloody diarrhoea and severe anaemia and in some cases death within few days. Generally, there was no response to the treatment with antibiotics, anthelmintics and multivitamins. The last animal that died was submitted for post-mortem examination. The disease affecting the herd was diagnosed as coccidiosis. This is the first report of caprine coccidiosis in the Green Mountain Area in Libya.

Key words: Coccidiosis, *Eimeria*, caprine, goat, small ruminant, Libya.

INTRODUCTION

Coccidiosis is an economically important disease. It affects a wide range of animals including cattle, sheep, goats, horses, camels, dogs and cats as well as different avian species (Hussein et al., 1987; Foreyt, 1997; Taylor et al., 2007; Pangasa and Singla, 2007; Pangasa et al., 2007; Singla et al., 2007). In goats and sheep, coccidiosis causes enteric disease resulting in diarrhea, inefficient weight gains and occasionally death (Foreyt, 1990). The disease in small ruminants is caused by some species of the genus *Eimeria* including *Eimeria christenseni*, *Eimeria caprina*, *Eimeria arloingi*, *Eimeria hirci*, *Eimeria ninakohlyakimovae*, *Eimeria aligevi* (Foreyt, 1997). Infection of goats with coccidiosis occurs through ingestion of sporulated oocysts. In the small intestine, sporulated oocysts release sporozoites which infect intestinal epithelial cells (Foreyt, 1990). The *Eimeria* spp are host-specific and are not transmitted from sheep to

goats. *E. arloingi*, *E. christenseni* and *E. ovinoidalis* are highly pathogenic in goat kids. The parasite is responsible for more 50% of the cases that showed hemorrhagic diarrhea in goat (Radad and Khalil, 2011). Clinical signs include diarrhea with or without mucus or blood, dehydration, emaciation, weakness, anorexia, and death. Some goats show constipation and die acutely without diarrhea (Kahn and Line, 2010).

Usually, stages and lesions are confined to the small intestine, which may appear congested, hemorrhagic, or ulcerated, and have scattered pale, yellow to white macroscopic plaques in the mucosa. Histologically, villous epithelium is sloughed and inflammatory cells are seen in the lamina propria and submucosa (Kahn and Line, 2010). The intestinal whitish nodules show proliferative enteritis with presence of different stages of the *Eimeria* in the hyperplastic epithelium (Kheirandish et

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Figure 1. Diffuse thickened intestinal mucosa with white multiple nodules at the surface and with haemorrhagic fluid content.

et al., 2012). In addition, hepatobiliary coccidiosis with liver failure in dairy goats has been reported (Kahn and Line, 2010). Here the first report of caprine coccidiosis in the Green Mountain Area in Libya is documented.

MATERIALS AND METHODS

A herd consisting of 200 heads of goats in a region belonging to Almarj city in the Green Mountain area was suffering from various symptoms. Subclinical cases which occur in most animals and in different ages which showed decrease in feed intake and weight gain, and with the absence of diarrhoea was looked into. Symptoms of clinical cases which occurred mainly in young animals less than one year old varied from some loss of appetite and decrease in weight gain and slight, short lived diarrhoea to severe cases involving great amounts of dark, bloody and foul smelling diarrhoea, fluidy feces containing mucous and blood, anaemia, loss of weight, rough hair coat, dehydration, and in some cases (11 cases) death within few days. Generally, there was no response to the treatment with antibiotics such as oxytetracycline, penicillin and gentamycin and many other anthelmintics and multivitamins. An animal that died was submitted for post-mortem examination. The excessive mesenteric attachments were trimmed off from the intestines and lymph nodes. Later on, the intestinal samples were cut into suitable segments. Fixation was carried out using 10% neutral buffered formalin. Samples were subjected to further processing steps that included dehydration, clearing, embedding, sectioning of 5 μ m thickness and routine Haematoxylin & Eosin staining. All slides were examined using light microscopy.

RESULTS

Gross pathology

Post-mortem examination revealed that the animal suffered from severe anaemia and moderate dehydration, the intestinal mucosa was thickened with a white nodular

surface and focal areas of haemorrhage (Figure 1). All other organs showed no significant pathological changes.

Laboratory results

Histopathological examination of hematoxylin and eosin (H&E) stained sections of jejunum revealed proliferative changes in the intestinal villi (Figure 2) and presence of different stages of coccidia in the enterocytes (Figure 3). Examination of mesenteric lymph nodes showed lymphocytic depletion and mild neutrophilic infiltration. All other organs showed no significant pathological changes. Microscopic examination of wet smear from the formalin fixed mucosa shows coccidia oocysts in the epithelial tissue (Figure 4).

DISCUSSION

Sheep and goat farming in Libya especially in the green mountain area is based on an outdoor grazing system which in combination with periods of high stocking density and poor husbandry contributes to an increased incidence of infectious diseases among different livestock. In case of coccidiosis, such grazing system helps to deposit oocysts from either infected or carrier animals into the environment and vice versa to infect new animals (Foreyt, 1997). Destruction of intestinal mucosa by coccidia results in hemorrhagic enteritis, as observed also in our report. In our case, histologically, intestinal mucosa showed proliferation of intestinal villi and presence of different coccidial stages in enterocytes. Moreover, mesenteric lymph nodes were slightly enlarged and showed lymphocytic depletion and mild

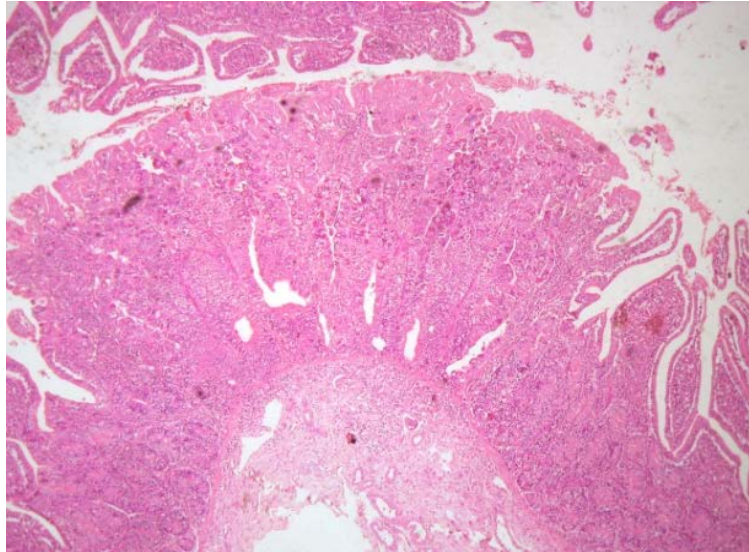


Figure 2. Histological section of jejunum showing proliferative changes of the intestinal villi. H&E stain, x40.

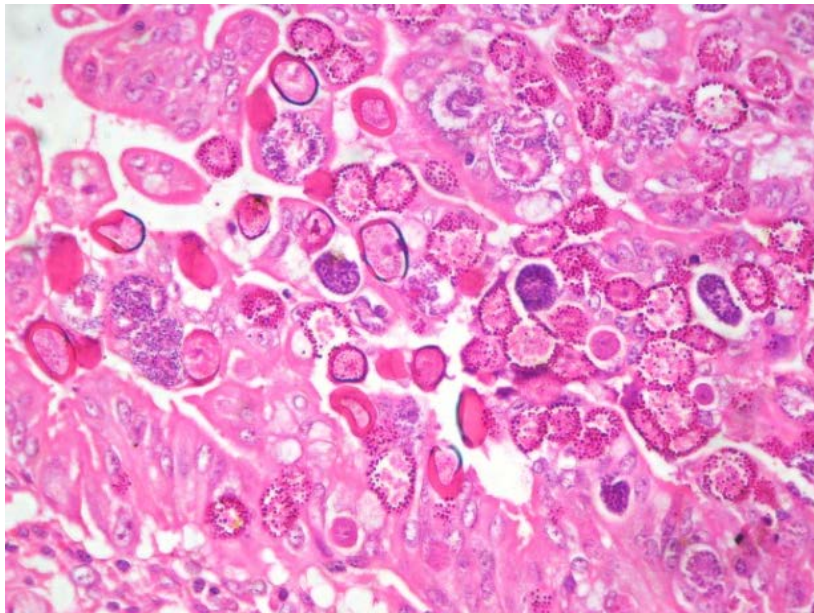


Figure 3. Presence of different stages of coccidia in the hyperplastic epithelium. H&E stain, x400.

neutrophilic infiltration. No coccidian parasites were observed in lymph nodes and recruitment of neutrophils to lymph nodes seemed to be due to secondary infection. All our results matched with previously published results (Koudela and Bokiva, 1998; Dai et al., 2006). However, coccidial schizonts were reported to be found in mesenteric lymph nodes of infected goats with *Eimeria apsheronica* (Kanyari, 1990).

Due to lack of information and the distribution of the

disease, and because the disease is not considered before the present study as one of the wasting diseases in ruminants in Libya, we advise to consider this disease as one of the responsible causes of the low production in this area and therefore, we can explain and diagnose cases due to chronic or acute coccidiosis. The parasite is widely spread and affects high percentages of sheep and goats. For example, the incidence of ovine coccidia in Egypt was 37% (Morrsy, 1983), and 41% in Saudi Arabia



Figure 4. Microscopic examination of wet smear of the affected mucosa shows coccidia oocysts in the epithelial tissue, $\times 1000$.

(Fawzia, 2007). Therefore, screening of the disease in Libya is also highly recommended and can easily be done using the simple microscopic examination. Control is aimed firstly at preventing access of goats to large numbers of oocysts, and secondly at reducing stress in the goats' environment. The use of preventive drugs is a third avenue of control that may be necessary in high-risk situations. Occurrence of this disease in this severity can be explained and discussed by the following reasons:

1. Failure of diagnosis of veterinarians because of the lack of laboratory diagnosis in these areas and therefore they do not use the proper medication to treat or reduce the coccidial outbreaks.
2. The use of anticoccidial drugs or feed additives is uncommon for sheep and goats in Libya. Therefore, the major anticoccidial drugs such as Amprolium in water and Decoquinate, Lasalocid, Monensin, Sulfaguanidine and Sulfamethazine in feed (Foreyt, 1997; Menzies, 2012) should be used to treat and prevent the disease in sheep and goats especially in the herds that suffer from decreased feed intake and weight gain.
3. Coccidial infections are self-limiting, and the host may develop immunity. So, the life cycle in such animals is progressively inhibited (Soulsby, 1982).

CONCLUSION AND RECOMMENDATION

In contrast, young animals are more susceptible more than old animals due to the acquired immunity, but it

should be considered that old animals can be act as source of infection for young animals and treatment should be given for all animals in the herd and may be in the neighbor's herds in such cases. Since the animals in these areas rely on grazing, the use of anticoccidial drugs in the feed will be of limited importance in such cases, therefore, we recommend using the treatment and prevention in drinking water.

Conflict of interest

Authors have none to declare.

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Full Length Research Paper

Parasitological and serological study of camel trypanosomosis (surra) and associated risk factors in Gabi Rasu Zone, Afar, Ethiopia

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Camel trypanosomosis (surra), caused by *Trypanosoma evansi*, is the most important single cause of morbidity and mortality in camels. Thus, a cross-sectional study was conducted from February to June, 2012 to investigate the parasitological and serological prevalence and associated risk factors of camel trypanosomosis in two camel rearing districts of Gabi Rasu zone, Afar region, Ethiopia. A total of 408 randomly selected camels reared under extensive husbandry management system were sampled for this study. Parasitological and serological examination was carried out by using haematocrit centrifugation technique (HCT) also known as Woo's technique and card agglutination test for trypanosomes (CATT/*T. evansi*), respectively. The overall parasitological and serological prevalence of camel trypanosomosis was found to be 5.15 and 23.77%, respectively. Nine out of twenty one camels that scored positive by the haematocrit centrifugation technique (HCT) test were negative by card agglutination test for trypanosomes (CATT/*T. evansi*), and the relative sensitivity of CATT/*T. evansi* test was found to be 57.14% (12/21). The mean packed cell volume (PCV) of parasitologically negative camels (24.27 ± 0.18) was significantly higher ($p < 0.05$) than that of parasitologically positive camels (20.71 ± 0.58). Serologically negative camels had a mean PCV of (24.27%) which was not significantly different from that of positive camels (23.48%). Risk factors associated with parasitological and serological prevalence were found to be "study district" and "age". Accordingly, camels in Awash Fentale district had significantly higher ($p < 0.05$) parasitological and serological prevalence of camel trypanosomosis than in Amibara district. Generally, surra was found to be prevalent in Awash Fentale district during the study period. Therefore detailed studies should be carried out on the seasonality of the disease and its vectors in order to establish the clear epidemiology of the disease.

Key words: Camel, Gabi Rasu, haematocrit centrifugation technique (HCT), prevalence, trypanosomosis.

INTRODUCTION

According to the United Nations (UN) Food and Agriculture Organization, the total world camel population is approxi-

mately 23 million animals (<http://faostat.fao.org>). In Ethiopia, around 1.7 million camels are estimated, which are mainly distributed in arid and semi arid lowlands of Borena, Ogaden and Afar regions, which cover 50% of pastoral areas of the country (CSA, 2007).

In Ethiopia, as in most dry lands of Africa and Asia, camels are the principal source of income and food for millions of pastoralists. The commonest uses of camels by the pastoralists are for milk and meat production, transporting grain, water, salt and other goods as well as for the determination of wealth and social status of pastoralists. They are very reliable milk producers even during the dry season and drought periods, when milk from cattle and goat becomes scarce (Gebre and Kayaa, 2008). In addition, camels play a central role in providing draught power and determining the wealth and social status of pastoralists. A study in Eastern Ethiopia indicated that camels work on average for 16 h per day, traveling 60 km (Tefera and Gebreab, 2004).

In spite of the valuable economic contribution to the pastoral communities, as well as to the National Gross Domestic Product (NGDP), little effort has been made so far to address the constraints of camel production. A few studies have been conducted however and these studies indicated that among other constraints, camel diseases are the major problems faced by camel producing communities throughout East Africa (Tekle and Abebe, 2001; Dirie and Abdurahman, 2003; Gebre and Kaaya, 2008, Megersa, 2010). Among the diseases, camel trypanosomosis also called surra, caused by *Trypanosoma evansi*, is the most important cause of morbidity and mortality in camels (Enwezor and Sackey, 2005). It is the most important single cause of economic losses of camel production, causing morbidity of up to 30% and mortality of around 3% in different camel rearing areas of the world (Enwezor and Sackey, 2005). A study conducted in southern Ethiopia indicates that trypanosomosis is one of the leading health problems (Tefera and Gebreab, 2004) and a prevalence of 21 and 10.5% were reported from Eastern and Southern parts of the country, respectively (Zelege and Bekele, 2001; Megersa, 2010). Despite many studies from Southern and Eastern parts of the country, to the best of our knowledge, there is no comprehensive information or valid literature on the prevalence of camel trypanosomosis in Afar regions and specifically in the current study area. However, effective control of camel trypanosomosis requires accurate baseline information on the prevalence and epidemiology of the disease and its vector. Therefore, the objective of this study was to investigate the prevalence of camel trypanosomosis and associated risk factors parasitologically and serologically.

MATERIALS AND METHODS

Description of the study area

The present study was conducted in two selected districts of Gabi Rasu zone, of Afar National Regional State, which is situated in the North Eastern part of the country. These two districts, namely Amibara and Awash Fentale, are located in the dry lowlands of the rift valley, at about 230 and 280 km, respectively from the capital Addis Ababa. The zone consists of six districts predominantly occupied by pastoral and agro-pastoral communities and it is characterized by arid and semi arid agro-climatic condition with ranging annual rainfall of 550 to 580 mm. Specifically, a long term average annual rainfall of 550 mm was reported for Awash Fentale by Abule et al. (2007), while 560 and 578 mm were reported for Amibara by Kidane (2005) and Kidanie (2010), respectively. The mean annual minimum and maximum temperature at Awash Fentale is 17.4 and 32.7°C (Abule et al., 2007), respectively, while the temperature is 19.5 and 34.4°C, respectively at Amibara (Kidanie, 2010). The area has two (a bimodal) rainy seasons with the main rainy season occurring from July to September and a short rainy season occurring from February to April (Abule et al., 2007; Kidane 2005). Land is generally flat and fertile with altitude ranges from 500 to 1500 metres above sea level (Abule et al., 2007; Kidane, 2005; Kidanie 2010). The predominant vegetation includes acacia species, mesquite (*Prosopis juliflora*), different bushes and other thorny shrubs (Kidane, 2005; Kidanie 2010). Some of the common important tree species in the area are *Acacia senegal*, *Acacia nilotica*, *Acacia melifera*, *Acacia nubica* and *Balenitus* spp.

Study design, sampling strategies and animals

A cross-sectional study was conducted from February to June, 2012, based on parasitological and serological examination, in a total of 408 randomly selected camels from Amibara and Awash Fentale districts. The two study districts were purposively selected to represent major camel rearing districts of the zone, based on their camel population and accessibility to vehicles. The sampling method for camel herds was also purposive (based on willingness of the owners) and simple random selection for the respective study animals. The total numbers of camels were proportionally sampled from both districts. Accordingly, 208 (51%) camel were sampled from Amibara district, and 200 (49%) were sampled from Awash Fentale district. The study animals included camels of different ages (young and adult) and of both sexes reared under extensive husbandry management system. The age of camels was determined based on the information obtained from the owners and were grouped as young (< 4 years old) and adult (> 4 years old).

Sample collection

After physical restraining of each selected camel, two parallel blood samples were collected through the jugular vein. Whole blood samples collected by jugular venipuncture into 5 ml ethylene diaminetetra acetate (EDTA) coated vacutainer tubes were subjected to parasitological examination using haematocrit centrifugation technique (HCT) also known as the Woo's technique (OIE territorial manual, 2010). On the other hand, blood samples collected using 10 ml plain vacutainer tubes were allowed to clot

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Table 1. Parasitological and Serological prevalence of camel trypanosomosis in Amibara and Awash Fentale districts of Gabi Rasu zone, Afar Region, Ethiopia.

District	No. of camels examined	Parasitological (HCT/Woo's)		Serological (CATT/ <i>T.evansi</i>)	
		No. of positive	Prevalence (%)	No. of positive	Prevalence (%)
Amibara	208	6	2.88	37	17.8
Awash Fentale	200	15	7.5	60	30
Overall	408	21	5.15	97	23.77

and then serum was harvested after 24 h. These serum samples were preserved at -20°C until they were used for detection of trypanosome antibodies using CATT/*T. evansi* test.

Laboratory examination procedures

Packed cell volume (PCV) and parasitology

Blood samples were drawn into paired 75 mm × 1.5 mm heparinized micro-haematocrit capillary tubes up to three-fourth of their length. The wet end of the tubes were sealed with plasticine, and then centrifuged at 12,000 rpm for 5 min, in a haematocrit centrifuge machine. PCV levels of individual samples were determined on haematocrit reader (Hawaksly, England) and the values of packed red blood cells (RBCs) to that of the total blood volume were expressed in percentages. As mentioned, parasitological examination were conducted using the haematocrit centrifugation technique, which can detect around 50 to 200 trypanosomes/ml of blood (Desquesnes and Tresse, 1996), by placing the capillary tubes into the groove of specially designed reading chambers for HCT. The presences of motile trypanosomes were examined at the junction between the buffy coat and the plasma under the microscope.

Serology

Serum samples were tested using the card agglutination for trypanosomosis test (CATT/*T.evansi*). The CATT/*T.evansi* is a direct rapid card agglutination test, which uses formaldehyde fixed, freeze-dried trypanosomes expressing a predominant variable antigen type of *T. evansi* (RoTat 1.2) stained with Coomassie blue (Bajyana Songa and Hamers, 1988). The test was carried out as described by Verloo et al. (1998). Accordingly, 25 µl of camel serum, diluted 1:4 in CATT-buffer, was pipetted onto a reaction zone of a plastic coated test card and then added with one drop (about 45 µl) of CATT reagent. The reaction mixture was spread out by a clean stirring rod and allowed to react on a card test rotator for 5 min at 70 rpm. Blue granular deposits reveal a positive reaction visible to the naked eye (OIE territorial manual, 2010).

Data management and analysis

The data was entered into a microsoft excel spread sheet to create a database and analysis of data was made using statistical package for social sciences software version 17.0 (SPSS, v. 17.0). Prevalence was calculated for all data set as the number of infected individuals divided by the number of individuals sampled multiplied by 100. Statistical analysis was performed to determine the relationship between the two diagnostic tests using Kappa

statistics, K. However, Chi-square test was used to analyze the association between surra positive camels in both tests and the assumed risk factors. Furthermore, mean PCV of parasitological positive and negative as well as serologically positive and negative camels for surra were compared using the two sample t-test. A significance level ($P < 0.05$) and confidence level (95%) was set to determine the presence or absence of statistically significant difference between the given parameters.

RESULTS

Parasitological and serological prevalence

The overall camel trypanosomosis prevalence rate in the study area was 5.15% (21/408) when haematocrit centrifugation (Woo's) technique was used, while it was 23.77% (97/408) with the card agglutination test for trypanosomosis (CATT/*T. evansi*) (Table 1). The parasitological and serological prevalence varied between the two districts and greater prevalence was recorded in Awash Fentale district than Amibara in both tests. Accordingly, parasitological prevalence rate in the Awash Fentale was 7.5% while that of Amibara was only 2.88%. Seroprevalence rate of surra was 30% for the Awash Fentale district, while it was 17.8% for Amibara (Table 1).

Comparison of parasitological and serological tests

Out of 21 camels with positive results in the parasitological test, 12 were positive using CATT/*T. evansi* test (Table 2). Nine camels that scored positive by the HCT test were negative under CATT/*T. evansi* (Table 2). Therefore, the relative sensitivity of CATT/*T. evansi* test employed in the present study was found to be 57.14% (12/21). Cohen's kappa was used to measure the concordance between the two tests and a 0.13 Kappa (K) score was found. The score indicates a slight agreement (Everitt, 1989) between the two tests.

PCV and camel trypanosomosis

The mean PCV of parasitologically negative camels

Table 2. The relationship between parasitological and Serological tests of camel trypanosomosis study in Gabi Rasu zone, Afar Region, Ethiopia

Technique	Parasitological (HCT/Woo's)			
	Status	Positive	Negative	Total
Serological (CATT/ <i>T. evansi</i>)	Positive	12	85	97
	Negative	9	302	311
	Total	21	387	408

Kappa (K) = 0.13

Table 3. Comparison of mean PCV of camels on the basis of parasitological and serological trypanosomosis status in Gabi Rasu zone of Afar Region, Ethiopia.

Camel trypanosomosis status	No. of observation	Mean PCV	Std. error	P-value
HCT+	21	20.71	0.585	0.000
HCT-	387	24.27	0.184	
CATT+	97	23.48	0.36	0.064
CATT-	311	24.27	0.20	

HCT+: parasitologically positive, HCT-: parasitologically negative, CATT+: serologically positive, CATT-: serologically negative

(24.27 ± 0.18) was significantly higher (p < 0.05) than that of parasitologically positive camels (20.71 ± 0.58). Serologically negative camels had a mean PCV of 24.27%, which was not significantly different from that of positive camels (23.48%) (Table 3).

Camel trypanosomosis and assumed risk factors

Categorical comparison of the prevalence of trypanosoma evansi between study districts, age groups and sex is shown in Table 4. There was significant difference (p < 0.05) in camel trypanosomosis prevalence between the two study districts. Higher trypanosome infection was recorded in Awash Fentale than Amibara district, both parasitologically and serologically. Age-wise analysis revealed that, there was significant difference in parasitological and serological prevalence between the two age groups, where higher infection rate was recorded in Adult (> 4 years) than in young (< 4 years) camels. With regard to sex, although parasitological and serological prevalence were relatively higher in female camels than males, these differences were not statistically significant.

DISCUSSION

The 5.15% overall parasitological prevalence of camel trypanosomosis recorded in this study is comparable with the investigations made by Abebe (1991), Kassa et

al. (2011) and Tadesse et al. (2012), who reported 6.54, 4.4, and 3.5% prevalence of *T. evansi* in camels, respectively, from different parts of Ethiopia. A study conducted in Somalia also showed 5.3% prevalence of *T. evansi* (Dirie et al., 1989). However, the present result is lower than the findings of previous workers who reported a prevalence of 12.1% (Hagos et al., 2009) and 10.5% (Megersa, 2010) in Ethiopia, 8.3% (Swai et al., 2011) in Tanzania and 13.72% (Shah et al., 2004) in Pakistan.

Lower prevalence rate of the present finding might be due to the variations in the ecology of the study areas and seasons of the year when the study was conducted. It is clear that season has direct effect on the distribution of biting flies, which are responsible for the mechanical transmission of *T. evansi* (Luckins, 1988). The current study was conducted during the dry season when the biting fly population is low. Furthermore, local epidemics of surra occur where conditions are favorable for the spread of infection with *T. evansi*, such as when many animals are stabled together or close herded and particularly when the biting fly population is abundant, commonly during the wet season (Luckins, 1988). Although the present study was conducted during dry season in both districts, significantly higher parasitological and serological prevalence was recorded in Awash Fentale district compared to Amibara. The higher prevalence observed in Awash Fentale district may be linked to the ecological conditions of the district where there are numerous animal watering points and the existence of big and medium sized trees and shrubs (Abule et al., 2007) along with a year round river called

Table 4. The effect of Study district, Age and Sex on Parasitological and Serological prevalence of camel trypanosomosis in Gabi Rasu zone, Afar Region, Ethiopia.

Risk Factor	Group category	No. of camels examined	Technique					
			Parasitological (HCT/Woo's)			Serological (CATT/ <i>T.evansi</i>)		
			No. of positive	Prevalence (%)	P- value	No. of positive	Prevalence (%)	P- value
Study district	Amibara	208	6	2.88	0.035	37	17.79	0.004
	Awash Fentale	200	15	7.5		60	30.00	
Sex	Male	43	1	2.33	0.376	6	13.95	0.110
	Female	365	20	5.48		91	24.93	
Age	Young	96	1	1.04	0.037	15	15.63	0.032
	Adult	312	20	6.41		82	26.28	

Awash River. As compared to the result obtained through the parasitological test (5.15%), the serological test showed higher prevalence (23.77%). This is in agreement with the findings of Hagos et al. (2009), who reported higher serological prevalence (24.9%) of camel trypanosomosis than its parasitological (12.1%) complement, in Bale zone, Ethiopia. Delafasse and Doutouin (2004) also reported a parasitological prevalence of 5.3% using Buffy coat technique (BCT) and a serological prevalence of 30% using CATT test, in Chad. The higher seroprevalence compared to the parasitological result recorded in the present study could be due to the fact that demonstration of trypanosomes in blood is quite unreliable since large proportions of infections (50 to 80%) in the field do not develop detectable level of parasitaemia (Killick Kendrick et al., 1968). This is because, infection with trypanosomes in camels is usually in chronic form during which they exhibit very low parasitaemia. Furthermore, the inability of CATT/*T. evansi* test to distinguish current from cured infection (Luckins and Mehlitz, 1978), as

detectable level of antibodies can still be found in self cured animals or after treatment with trypanocidal drugs (Desquesnes et al., 1999), might also explain the higher prevalence difference under the two tests. Although CATT was sensitive in identifying 86 latent/aparasitaemic infections, the test was unable to detect 9 of 21 (42.86%) patent/parasitaemic infections (Table 2). The CATT/*T. evansi*, a direct agglutination test, is the most widely applied test and has a proven record of reliability for different host species, such as buffaloes and camels (Gutierrez et al., 2000; Holland et al., 2002).

The test is based on the native variant surface glycoprotein (VSG) of the predominant variable antigen type (VAT) RoTat 1.2 of *T. evansi* (Bajyana and Hamers, 1988). A high sensitivity (86 to 100%) of CATT test was reported from different geographical regions of the world (Bajyana and Hamers, 1988; Gutierrez et al., 2000; Verloo et al., 2000; Abdel-Rady, 2008). However, sensitivity of CATT/*T. evansi* RoTat 1.2 in the present study was found to be 57.14%. This

lower sensitivity of CATT test recorded in the present study is in agreement with previous studies in Kenya who reported 65.5% (Ngaira et al., 2003) and 68.6% (Njiru et al., 2004) sensitivity. Similarly, Hagos et al. (2009) reported 72% sensitivity of CATT/*T. evansi* from Ethiopia. A lower sensitivity or a high false negative result of CATT test in the present study might result from the following likely scenarios. First, a non RoTat 1.2 *T.evansi* isolates (*T. evansi* type B) might have existed from camels of the study area; because, a number of *T. evansi* type B isolates has been reported not to express the RoTat 1.2 VAT and serological tests based on RoTat 1.2 of *T. evansi* remained negative in Kenya (Ngaira et al., 2003; Ngaira et al., 2005).

Second, other trypanosoma species (*Trypanosoma vivax*), might be the other possible isolates from camels of the present study area because, it is necessary to take into consideration the various trypanosoma species present in a given area (OIE territorial manual, 2010). Therefore, an emphasis is necessary to address the problem of diagnosis of *T. evansi* in the region.

It is also important to note that serological tests need to be validated and standardized, if they are to be suitable for correct identification of infected animals; cross evaluation in different laboratories is thus required. The explanations given for false negative results of CATT test in the present study may assist future studies to improve the test accuracy.

The significantly higher mean PCV of parasitologically negative camels than the positive ones, observed in the present study, is in agreement with the reports of Tadesse et al. (2012). This suggests that anaemia was the major clinical finding of surra. The situation in serological test was different; showing no significant difference in mean PCV of serologically negative camels and that of seropositive ones. This might be due to the limitation of CATT test to distinguish antibodies due to active infection from those of cleared or past infections, as previously suggested by Luckins and Mehlitz (1978). Therefore the PCV values of cured camels from surra (past infections) which are serologically detected as positive, are not significantly different from seronegative ones (Bengaly et al., 2001) and highly reduced PCV values occur when trypanosome parasites were detectable in blood.

Age significantly influences the parasitological and serological prevalence, where a higher infection rate was recorded in adult camels compared to the young ones. This finding is in general agreement with Dia et al. (1997), Gutierrez et al. (2000), Atarhouch et al. (2003) and Tadesse et al. (2012), who reported a tendency for infection rate to increase with age. This could be due to larger scale movement, which increases the risk of infection in adult camels (Delafosse and Doutoum, 2004; Bhutto et al., 2010), heavy stress on adult male camels being used for transportation of goods and their possible poor management (Shah et al., 2004) as well as stress associated with pregnancy and lactation in adult female camels (Bhutto et al., 2010).

Conclusion

The present study provides useful baseline data on the prevalence of camel trypanosomosis in the study area, and the results indicated that camel trypanosomosis is prevalent in Awash Fentale district. Considering the widespread existence of the disease and its significant impact on camel productivity, detailed epidemiological studies should be carried out on the seasonality of the disease and its vectors in order to establish integrated vector and parasite control strategies.

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Conflict of interest

The authors declare that they have no competing interests.

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Full Length Research Paper

Prevalence of bovine fasciolosis in and around Inchini town, West Showa Zone, Ada'a Bega Woreda, Central Ethiopia

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The study was conducted from November, 2008 to March, 2009 in six kebeles of Ada'a Berga Woreda, West Showa Zone, in and around Inchini town and indicated that bovine fasciolosis is widely spread with high prevalence, inducing economic loss to livestock production in the region. From a total of 573 cattle coprologically examined during the study period, 291 animals were found positive for liver fluke infection with an overall prevalence rate of 50.79%. There was no statistically significant difference ($p > 0.05$) in infection rates between male and female animals. Analysis of infection rates on the basis of age of cattle indicated negative or inverse correlation and there were significant differences ($p < 0.05$) between different age groups. A significant difference ($p < 0.05$) was observed among studied months with highest monthly prevalence in November and lowest in January. The infection rates (60.48%) were significantly higher ($p < 0.05$) in poor body condition than good body condition animals (11%) and this signifies the importance of fasciolosis in causing weight loss which is the characteristic sign of chronic fasciolosis. Of the total 196 bovine livers examined at Inchini municipal abattoir, 107(54.49%) animals were found positive for liver fluke and 68.22% of livers harbored *Fasciola hepatica*, 8.04% *Fasciola gigantica* and 23.37% infected by both species of *Fasciola*. This study indicates fasciolosis is the major parasitic health problem in the area and creates economic impact by condemnation of the affected liver. Therefore, proper attention should be paid for strategic deworming, animals should not be allowed to graze in water reservoir areas and further research on meteorological condition of snail infection is highly recommended.

Key words: Abattoir, Ada'a Berga, bovine, fasciolosis, prevalence, West Showa zone.

INTRODUCTION

Bovine fasciolosis is an economically important parasitic disease of cattle caused by trematodes species of the genus *Fasciola*, which migrate in the hepatic parenchyma

and establish and develops in the bile ducts. Fasciolosis caused by *fasciola hepatica* and *Fasciola gigantica*, is one of the most prevalent helminth infection of ruminants

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in different parts of the world. It causes significant morbidity and mortality (Okewole et al., 2000; WHO, 1995).

The snails of the genus *lymnae* are mainly involved as an intermediate host in the life cycle of fasciolosis. The epidemiology of fasciolosis is dependent on the ecology of the snail intermediate host. *lymnae truncatula* is the most common intermediate host for *fasciola hepatica* in different part of the world (Njau et al., 1991) and in Ethiopia (Graber et al., 1975). It is an amphibious or a mud-dwelling snail which prefers moist temperature condition (15 to 22°C) though it appears that variants found in the tropics have adaptation to higher temperature mostly in the lowland areas and can breed and survive at 26°C with sufficient moistures. The most important intermediate hosts of *Fasciola gigantica* are *Leptodactylus natalensis* and *Leptodactylus auriallaria* (Urquhart et al., 1996; Dunn, 1978; Soulsby, 1982). *L. natalensis* is the recognized intermediate host for *F. gigantica* (Yilma and Malone, 1998). This snail is strictly an aquatic snail often found in Africa and requires well oxygenated none polluted water bodies and can aestivate during dry periods. Optimal temperature requirement for the completion of parasite developmental stages within the snail is 22 to 26°C. However, in irrigated areas, snail breeding is less circumscribed and well continues all year around, except for period's extreme temperature levels (Souls, 1982).

F. hepatica is a temperate species and it is found in Southern America, Northern America, Europe and Australia and Africa, but found in the highlands of Ethiopia and Kenya. It is the major cause of liver fluke disease in Ethiopia. Its tropical counterpart, *F. gigantica*, on the other hand is widely distributed in tropical countries, in Africa and Asia. In Ethiopia, *F. gigantica* is found at an altitude below 1800 m above sea level while *f. hepatica* is found at altitude between 1200 to 1560 m above sea level (Yilma and Malone, 1998). Mixed infection by the two species can be encountered at 1200 to 1800 m above sea level (Mulugeta et al., 1989).

The clinical features of fasciolosis can have acute, sub acute and chronic forms. Acute fasciolosis occurs as disease outbreak following a massive, but relatively short-term, intake of metacercariae (Urquhart et al., 1996). The high fluke intake is often the result of certain seasonal and climatic conditions combined with a lack of appropriate fluke control measures. It typically occurs when stocks are forced to graze in heavily contaminated wet areas as a result of over stocking and /or drought. Animals often affected by acute fasciolosis especially sheep and goat may display no clinical signs prior to death while some may display abdominal pain, discomfort and may develop jaundice (Souls, 1982; Urquhart et al., 1996). Death usually results from blood loss due to hemorrhage and tissue destruction caused by the migratory juvenile flukes in the live resulting in traumatic hepatitis (Urquhart et al., 1996).

Sub-acute fasciolosis is caused by ingestion of a moderate number of metacercariae and is characterized by anemia, jaundice and ill-thrift. The migrating fluke causes extensive tissue damage, hemorrhage and in particular liver damage. The result is severe anemia, liver failure and death in 8 to 10 weeks (Urquhart et al., 1996). Chronic fasciolosis is the most common clinical syndrome in sheep and cattle. It occurs when the parasite reaches the bile ducts. The principal effects are bile duct obstruction, destruction of liver tissue, hepatic fibrosis anemia and submandibular edema (Mitchell, 2003). In addition to these, a condition known as "black disease" is a complication, which usually is fatal. Here, a secondary infection due to the bacterium *clostridium novyi* type B, proliferating in necrotic lesions produced by the young larvae migrating in the liver is responsible for the fatal outcome (Radostits et al., 2007). Chronic fasciolosis provides the right environment in the liver for the germination of the spores of the bacterium. This form of the disease is much more common particularly in man. In humans the presence of the flukes causes a number of non-specific symptoms including malaise, an intermittent fever, mild jaundice, anemia eosinophilia and frequently pain under the right costal margin (Chhabra and Singla, 2009). Furthermore, *fasciola* species do not appear to be fully adapted to using man as a definitive host, as the flukes may often give rise to entopic infections, particularly in the lungs and sub cutaneous tissues, where they may be found encysted (Slifko et al., 2000).

Pathogenesis of fasciolosis varies according to the parasitic development phases parenchymal and biliary phases. The parenchymal phase occurs during migration of flukes through the liver parenchyma and is associated with liver damage and hemorrhage. The biliary phase coincides with parasite residence in the bile ducts and results from the haematophagic activity of adult flukes and forms the damage to the bile duct mucosa by their cuticular spines (Urquhart et al., 1996).

Hypoalbuminemia and hypoglobulinemia commonly occur in liver fluke infections in all host species. During the parenchymal stage of the infection, liver damage caused by the migrating flukes compromise liver function, which was reflected in decline in plasma albumin concentrations, attributed partly, to reduce rate of synthesis and partly to an expansion of the plasma volume (Behm and Sangstes, 1999; Urquhart et al., 1996).

Fasciolosis is known by different local names in various part of Ethiopia that vary according to the region and language. In Amharic it is called 'kulkult', 'Wadammo', 'Yegubet till'. In Oromia region it is known as 'Dada'o', 'Losh'a', and 'Rammo tiruu'. In Tigray language it is termed as 'Ifil' (Adem, 1994).

The economic losses caused by bovine fasciolosis indicated that the productive efficiency was reduced by 8% in mild infection and over 20% in severe infection. In sub Saharan Africa, data on bovine fasciolosis reported up to 60% incidence rates, up to 50% liver condemnation

rates, up to 5% reduction in weight gain (Ross, 1970; Hyera, 1984), 16% loss in daily milk production (Bahru and Ephrem, 1979) and annual loss of 198kg of body weight per fluke (Ogunrinade et al., 1982).

Diagnosis of fasciolosis may consist of tentative and confirmatory procedures. A tentative diagnosis of fasciolosis may be established based on prior knowledge of the epidemiology of the disease in a given environment, observation of clinical sign, information on grazing history and seasonal occurrence. Confirmatory diagnosis however, is based on demonstration of fasciola eggs through standard examination of faeces in the laboratory, post mortem examination of infected animals and demonstration of immature and mature flukes in the liver (Souls by, 1982; Urquhart et al., 1996).

Several workers have reported the presence and economic significant of fasciolosis in Ethiopia. The prevalence of the disease is known to be relatively high (Bahru and Ephrem, 1979) causing considerable economic loss in livestock production. However, few attempts have been made to study the epidemiology of this parasitic problem in various section of the country with the specific aim of determining the parasitic burden, especially in relation to months of the year, rain fall, temperature, humidity, altitude and other related factors. This information is very important in planning control programs and also estimating the economic burden to the country as a result of this parasite.

Ada'a Berga is found in suitable geo ecological zone for occurrence of fasciolosis and the area has also several water reservoirs. However, little information is available regarding the coprological and abattoir prevalence of fasciolosis. Therefore, this study was aimed to know the prevalence of bovine fasciolosis in and around Inchini town, to determine the liver pathology and to the generate base line data for future research of bovine fasciolosis on the study area.

MATERIALS AND METHODS

Study area

The study was conducted from November, 2008 to March, 2009 in and around Inchini town, Ada'a Berga Woreda, West showa Zone, Central Ethiopia. Geographically, the area is located at 64 km North west of Addis Ababa on the road of Mughher cement Enterprise and located at 9° 12' to 9° 37' N latitude and 38° 17' to 38° 36' E longitude. According to the publication bureau of planning and economic development for Oromia regional state, West showa office (1998) the maximum and minimum temperature of the woreda is 25 to 10°C, respectively and an annual rain fall ranging from 918 to 1368 mm and an altitude ranges from 1400 to 3270 m above sea level.

Ada'a Berga Woreda has a climatic condition of 21% highland, 54% mid latitude and 75% lowland. Based on the altitude, there are three main agro-climatic regions can be identified, "Daga" (28%), "Winodega" (38%) and "Kola" (34%) areas. The soil types in the area are black (43%), Red (37%) and Brown (mixed) (25%). The rain is bi-modal with short rainy season, february to march and long rainy season from june to september. According to the information

obtained from the veterinary section of Ada'a Berga Woreda veterinary clinic Report, 2007/2008, the total live stock population of this Woreda was estimated as 119,277 cattle, 42,308 sheep, 51,828 goats and 20,685 equines.

Study animals

A total of 573 cattle found in Inchini town and its surroundings (Deku kitto, Gatira Nabe, Bishan Dimmo, Maru Chobot and Sire Berga) were selected randomly from each kebeles and subjected to qualitative coproscopic examination. In this study both indigenous and cross breeds of animal found under the extensive grazing systems were included. In the abattoir study, adult male and female indigenous animals were provided for slaughter from different localities in the woreda's and surrounding areas. Prior to slaughtering, animals were identified using their identification numbers and all important information were recorded on prepared format.

Study design

A cross-sectional study was designed to determine prevalence of fasciolosis in the area. Coprological examination of live animals and post mortem survey on animal (cattle) slaughtered at Inchini municipal Abattoir were carried out in this study. Moreover, pathological lesion of livers was categorized.

Coprological examination

Fecal samples were directly collected from the rectum of each and were transported to Akilu Lemma Institute of Pathobiology (ALIPB) for detailed coprological examination. Samples that were not processed within 24 h of collection were stored in a refrigerator at 4°C. In the laboratory, coproscopic examinations were performed to detect fasciola eggs using the sedimentation (Hansen and Perry, 1994). Age estimation of animals involved in the study was done based on their dental eruption formula and number of rings on their horns; the age of the animal were determined and classified as young (< 4 years) and adult (> 4 years) (Cringoli et al., 2002). Body condition scoring of animals involved in the study was made according to Nicholson and Sayers (1986). The score ranges from 1 (emaciated) to 5 (very good) by observing the body conformation of the animal. Then scores were classified as poor (for 1, 2 and 3 BCS) and good (for 4 and 5, BCS).

Abattoir survey

Livers of slaughtered animals (196) at Inchini municipal abattoir during study period were carefully inspected for presence of liver flukes first by visual inspection to observe enlarged bile ducts and irregularity of the morphology of the liver, then by palpation and carrying out multiple incisions of all visible bile ducts and their branches to look for adult fasciola lodged there. Sex and breed and result of the slaughtered animals were registered. The recovered liver flukes during the survey in slaughter house were morphologically (on basis of size and shape) identified as *F. hepatica* and *F. gigantica* (Souls, 1982) and pathology of affected livers were grouped into three; slightly affected: if none or only one enlarged or duct is seen before cutting and cutting revealed enlarged or calcified bile ducts and/ or flukes; moderately affected: if more than one enlarged bile duct was visible before cutting and severely affected: if atrophy of left lobe and hyperplasia of the right lobe is seen giving the liver triangular shape (Ogunrinade et al., 1982).

Sample size determination

A random sampling method was employed in both study type (field and abattoir survey). To determine the sampling unit, the sampling frame consists of a list of 31 PAs of Ada'a Berga Woreda were obtained from the documents of the agricultural office of the Woreda. Then six kebeles from 31 PAs were randomly selected by lottery systems. The samples were taken by simple random selection from each six kebeles. To determine the sample size, a fasciolosis prevalence rate of 50% was taken into consideration since there was no research work on fasciolosis in the area. The desired sample size for the study was calculated using the formula given by Thrusfield (1995) with 95% confidence interval and 5% absolute precision.

$$n = \frac{(1.96)^2 P \exp(1 - P \exp)}{d^2}$$

Where: n= sample size. P exp= Expected Prevalence. d^2 = Absolute precision

Accordingly, the estimated sample size was 384 animals; however, to increase the precision 573 cattle were included in the study.

Statistical analysis

Data was entered into Ms excel and checked for errors that occurred during data entry. Any error was sorted and corrected. Finally, data analysis was made through STATA 7.0 version. The association of fasciola infection rates on the basis of age, sex and body condition was compared using X^2 test (chi-square). Infection rates on the basis of age and sex on the prevalence of fasciolosis were also analyzed by the Pearson's correlation coefficient (Putt et al., 1988). P-Value < 0.05 was considered as statically significant.

RESULTS

Coprological findings

Examination of 573 feecal sample revealed that 291 (50.79%) were found positive for fasciola eggs. There was no significant difference between study kebeles. However, highest prevalence was observed at Gattira Nabe (67.05%) kebele followed by Bishan Dimmo (55.56%), Deku kitto (48.74%), Inchini (45.46%), Maru Chobot (43.10%) and the lowest was seen at Sire Berga (37.78%) (Table 1). There was significant difference among study months ($p < 0.05$). The highest prevalence of fasciolosis was noted in November (90.04%) and December (80.34%), that is during the beginning of the dry season and the least prevalence was recorded in January (17.89%) and February (18.69%) that is during the dry season (Table 2). Present study indicated 50.39 and 51.09% prevalence of fasciolosis in male and female, respectively. No significant difference ($p > 0.05$) was seen between sexes (Table 3). Analysis of the prevalence rates in different age group showed negative/inverse correlation that is, as age increases the infection decreases. Similarly, there was also statistically significant difference ($P < 0.05$) among cattle of different

age groups (Table 4).

The result of present study showed a significant difference among body condition score ($p < 0.05$). Infection rates of fasciolosis in 'Poor' body condition group was significantly higher than animals with good body condition group (Table 5). Regarding breeds, prevalence rates of 56.94% in local breeds and 14% in Holstein cross (Friesian \times Horoo) breed were registered. Analysis of the result of breed basis shows significant variations ($P < 0.05$) (Table 6).

Abattoir survey

Out of 196 livers of slaughtered animals examined, 107 livers found infected with adult liver fluke of which highest infection was recorded due to *F. hepatica* 73 (68.22%), *F. gigantica* 9 (8.41%) and 25 (23.36%) mixed infection with both *F. hepatica* and *F. gigantica* (Figure 1). Analysis of liver lesion intensity of 107 infected livers indicated that 51(48%) were lightly affected, 42 (39%) moderately and 14 (13%) severely infected (Figure 2).

DISCUSSION

Bovine fasciolosis exists in almost all regions of Ethiopia (Graber, 1975; Bahru and Ephrem, 1979). However, the prevalence rate, epidemiology and *Fasciola* species involved vary with locality. This is mainly attributed to the variation in the climatic and ecological conditions such as altitude, rainfall, temperature and management systems of livestock. Based on the result of this study, bovine fasciolosis found a significant disease in Ada'a Berga woreda, with an overall prevalence of 50.79%. This is in close agreement with other reports, such as 86% in keffa (Bahru and Ephrem, 1979), 84.4% at Bahir Dar abattoir (Fekadu, 1988), 80% in and around Debre Berhan (Dagne, 1994) and 82.5% in Western Showa (Yadeta, 1994). However, majority of these reports are higher prevalence as compared to current prevalence. This may be due to the expansion of animal health extension and veterinary services that means the opening of animal health post at kebeles/peasant association level and the intervention of nearby private veterinary drug shops (pharmacies). This enables the farmers to have more access for disease control and intervention.

Infection rate of bovine fasciolosis in Gattira Nabe was relatively higher than the other five study sites; this may be attributed to the existence of more favorable environment for both the snail intermediate host and the parasite in Gattira Nabe kebele which has heavy dark-brown clay soil (with slightly acidic PH), which has high capacity of water retention and is mostly marshy area for long periods during the dry season.

The overall abattoir survey prevalence of bovine fasciolosis (45.59%) observed in this study is in harmony with report of Bahru and Ephrem (1979) from Gondar,

Table 1. Prevalence of bovine fasciolosis at different Kebeles in and around Inchini town

Site	No. examined	No. of -ve animals	No. of +ve animals	Prevalence (%)
Deku Kitto	277	142	135	48.74
Gatira Nabe	88	29	59	67.05
Bishan Dimmo	72	32	40	55.56
Maru Chobot	58	33	25	43.10
Sire Berga	45	28	17	37.78
Inchini 01	33	18	15	45.46
Total	573	282	291	50.79

Pearson $\chi^2 = 15.2205$, $pr = 0.009$

Table 2. Monthly prevalence rate of fasciolosis in the field survey

Month	No. examined	No. Negative	No. Positive	Prevalence (%)
November	135	13	122	90.04
December	102	20	82	80.39
January	123	101	22	17.89
February	107	87	20	18.69
March	106	61	45	42.45
Total	573	282	291	50.79

Pearson $\chi^2 = 220.72$, $Pr = 0.000$.

Table 3. Prevalence of Bovine Fasciolosis on Sex basis.

Site	No. of examined animals	No. of -ve animals	No. of +ve animals	Prevalence (%)
Male	254	126	128	50.39
Female	319	156	163	51.09
Total	573	282	291	50.79

Pearson $\chi^2 = 0.0280$, $Pr = 0.867$.

Table 4. Prevalence of bovine fasciolosis in different age group

Age group	No. of examined animals	No. of -ve animals	No. of +ve animals	Prevalence (%)
Adult	100	79	21	21
Young	473	203	270	57.08
Total	573	282	291	50.79

Pearson $\chi^2 = 42.9997$, $Pr = 0.000$.

Yehenew (1985) around Lake Tana, Fekadu (1988) around Bahir Dar and Yohannes (1994) from Bahir Dar abattoir reported prevalence rates of 61, 56, 62.2 and 61.97%, respectively. However, the prevalence report of these workers are relatively higher than the present

finding and this variation might be attributed to the differences in the infestation level of the study areas and the previous works were conducted during the wet period of the year when infestation rates of fasciolosis is expected to be high.

Table 5. Prevalence of bovine fasciolosis and body condition scoring.

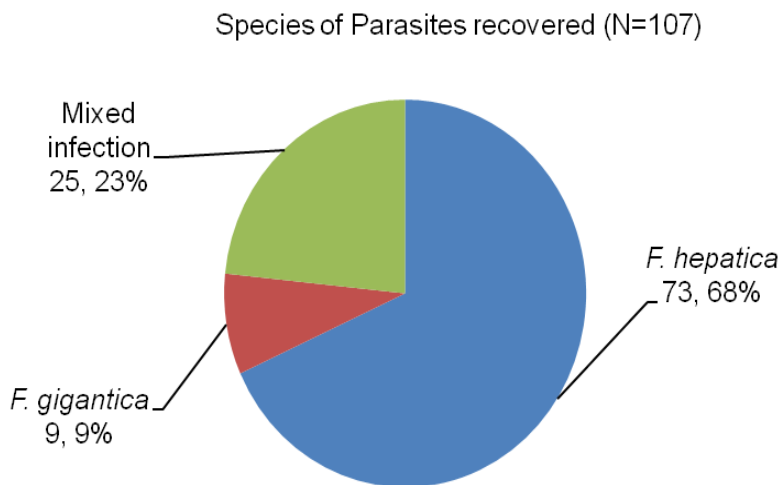
Body condition	No. of examined	No. of positive	Prevalence (%)
Poor (BCS 1, 2 & 3)	463	280	60.48
Good (BCS 4 & 5)	108	11	11
Total	573	291	50.79

Pearson $\chi^2 = 126.4644$, Pr = 0.000.

Table 6. Prevalence of bovine fasciolosis in local and cross breed.

Breed	No. of examined animal	No. of -ve cases	No. of +ve cases	Prevalence (%)
Local	490	211	279	56.94
Cross	83	71	12	14.46
Total	573	282	291	50.79

Pearson $\chi^2 = 51.2478$, Pr = 0.000.

**Figure 1.** Species of *Fasciola* encountered in affected livers during postmortem examination.

Prevalence rate of 50.39 and 51.09% was recorded in male and female animals, respectively. There was no statistically significant difference ($P > 0.05$) between the two sexes, this signifies that sex has no impact on the infection rate and both male and female animals are equally susceptible and exposed to the disease. Similar results that support the present finding were reported by Yehenew (1985), Fekadu (1988), Rahmeto (1992) and Dagne (1994). However, some workers found higher prevalence rate in the male than female; their justification is related to the management system with longer exposure of males out door when females are kept indoor at the beginning of lactation (Balock and Arthur, 1985).

Statistical analysis of infection rates on the basis of age

indicated a significant differences ($P < 0.05$) among different age groups. The decrease in infection rate (prevalence rate) as age increase is the result of acquired immunity which is manifested by humoral response and tissue reaction in bovine liver due to previous challenge (Ogunrinade et al., 1982). Dwinger et al. (1982) also reported the increased resistance (low prevalence) as age increases is most likely related to the higher level of tissue reaction seen in bovine liver, severe fibrosis which impedes the passage of immature flukes, acquired resistance, thickening, stenosis and calcification of bile ducts, assumed unfavorable site for adult parasites and consequently fasten their expulsion. Consistent with current finding, several studies done by Fekadu (1988),

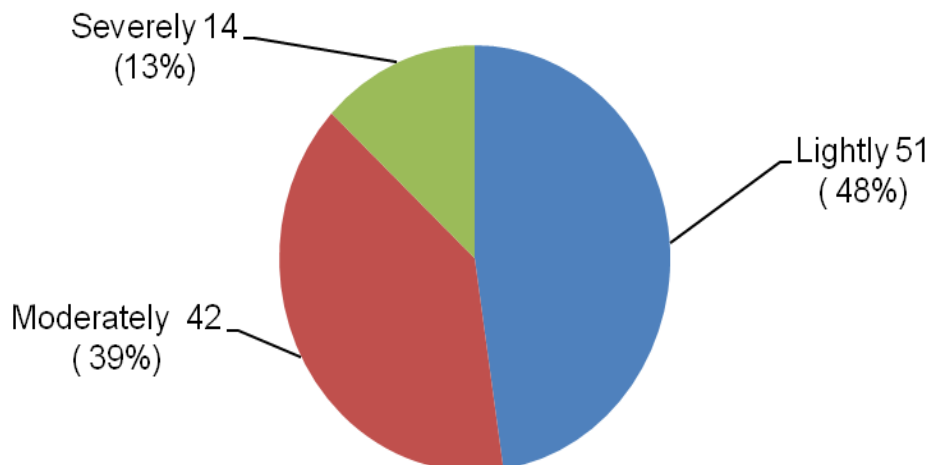


Figure 2. Number of liver affected and its conditions of the pathological lesion.

Rahmeto (1992) and Dagne (1994) in different parts of Ethiopia stated inverse correlation of prevalence rate and age of cattle.

There was a statistically significant association ($p < 0.05$) between fasciola prevalence and body condition of the animals in which infection rates in poor body condition animals was significantly higher than that of good body condition. This signifies the importance of fasciolosis in causing weight loss and is the characteristic sign of the disease. Chronic fasciolosis is the commonest form of the disease in cattle and one of the characteristic sign is weight loss (emaciation) (Graber, 1975; Troncy, 1989; Urquhart et al., 1996). This finding concur with study report of Bekele (2010) reported high prevalence in cattle with poor body condition compared to cattle in medium and good body condition.

The species of fasciola involved in causing the disease in the study area was studied on 107 fasciola infected livers during postmortem examination of slaughtered animals. The result of the study indicated *F. hepatica* (68.22%), *F. gigantica* (8.41%) and mixed infections (23.36%). The predominant species involved in causing bovine fasciolosis in the study area is *F. hepatica* and is associated to the existence of favorable ecological condition for the study area such as swamp areas around the lake and marshy areas in the low-lying plain areas and temporary shallow ponds favorable habitat for *I. truncatula* (intermediate host of *F. hepatica*) and this allows the existence of *F. hepatica* in the study area. Borders of lake, Flood-prone areas, and low-lying marshes and drainage ditch areas are favorable habitat for *I. natalensis* (intermediate host of *F. gigantica*) (Troncy, 1989).

Mixed inflection by both species of fasciola may occur in the liver of the same animal and this attributed to the existence of ecological conditions conducive for replication of both species of snails and intermingling of

cattle from various grazing areas. Similar results which support the present finding were reported by Graber (1975), Fekadu (1988) and Adem (1994). This is attributed mainly to the variation in the climatic and ecological conditions such as altitude, rainfall temperature and livestock management systems (Yilma and Malone, 1998). Additionally Graber (1975) and Dagne (1994) reported that in Ethiopia *f.hepatica* and *F. gigantica* infection occur in areas above 1800 m.a.s.l and below 1200 m.a.s.l., respectively which supports the present study.

CONCLUSION

The present study concluded that fasciolosis is the most wide spread and prevalent parasitic disease affecting the health and productivity of animal in the study area. Additionally, abattoir study revealed that bovine fasciolosis is prevalent disease in the study area, causing great economic losses as a result of condemnation of affected liver.

RECOMMENDATIONS

Proper attention should be paid for strategic deworming; animals should not be allowed to graze in water reservoir areas. Moreover, further research on the epidemiology of the disease, biology and ecology (meteorological) of intermediate host snails (*Iymnaea*) to overcome difficulties in planning and programming control strategies is highly recommended.

Conflict of interest

Authors have none to declare.

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