Original Article

Small ruminant brucellosis and awareness of pastoralist community about zoonotic importance of the disease in Yabello districts of Borena Zone Oromia regional state, southern Ethiopia

Wubishet Zewdie Wakene [1*], Sadik Kasim[1], Abdi Ahmed[1], Abdallah Bulbula[1], Huqa Liban[1], Alemayehu Bulcha[1], Mokonin Belete[1], Getachew Abichu[2], Getachew Kinfe[2]

1- Oromia Pastoralist Development Commission Yabello Regional Veterinary Laboratory, Yabello, Ethiopia
2- National Animal Health Diagnostic and Investigation Center(NAHDIC) Sebeta, Ethiopia

[*]**Corresponding author:** *wubevet1921@gmail.com*

(Received 25 June 2017, Accepted 11 October 2017)

Summary

Brucellosis is a zoonotic disease affecting the wellbeing of human and animals mainly in developing countries. Small ruminants are highly adaptable to broad range of environmental conditions and are the most important income sources for poor households. A cross sectional study was carried out on a total of 283 animals (99 sheep and 184 goats) from October 2016 till April 2017 to estimate seroprevalence of small ruminant brucellosis. In addition, a structured questionnaire was filled out by 126 respondents of 10 peasant associations (PA's) to assess community awareness about zoonotic importance of diseases. The overall seroprevalence of the brucellosis in small ruminant was 23 (8.1%) (95% CI: 5.2, 11.9) revealed by c-ELISA. The individual species seroprevalence of brucellosis was 9.2 (95%CI: 5.5, 14.4) and 6.1(95%CI: 2.3, 12.7) in goat and sheep, respectively. Among 126 respondents, 112 (88.9) of had no knowledge about zoonotic importance of brucellosis and its transmission routs, whereas 14 (11.1%) of them were aware of the disease. Consequently, the majority of the respondents handled all aborted fetus; assisted their animals during the parturition by bare hand without any protective clothing, consumed raw milk and animal blood. In addition, the physicians were not aware of the disease and they did not consider the brucellosis while treating patient submitted to health post with suggestive clinical sign of brucellosis. Therefore, integrated human and veterinary doctors' disease control strategy should be developed and applied to control the disease both in human and animals.

Keywords: Borena, Brucellosis, Pastoralist, Public awareness, Small ruminant.

Introduction

Small ruminants are highly adaptable to broad range of environmental conditions and are the most important income sources for poor households. In addition, it bases livelihood of poor family members in tropical livestock production systems in Africa (ILRI, 2006). Goats and sheep account about 21% of the global small ruminant population in Africa. Small ruminants fulfill a number of economic and social functions. According to the statistics from the Central Statistical Agency (CSA, 2005), Ethiopia has over 18 million head of

sheep and 24 million goats. Twenty-five percent of the sheep and 73% of the national goat population inhabit the lowlands mostly pastoral areas (PF, 2004). However, different factors such as; management problems and poor animal disease control strategies affect the production and productivity of small ruminant in the area.

Different livestock diseases can also affect production and productivity of livestock in Africa including Ethiopia. The diseases could be viral, bacterial or parasitic. Brucellosis is a highly contagious bacterial disease of animal which has zoonotic importance causing significant reproductive losses in animals. Members of the genus *Brucella* are gram-negative, facultative intracellular pathogens that may affect a wide range of mammals including humans, cattle, sheep, goats, pigs, rodents, and marine mammals (Cutler et al., 2005). It is endemic disease in African countries among ruminants and humans (Holt et al., 2011). Brucellosis in livestock and humans is still common in the Middle East, Asia, Africa, South and Central America, the Mediterranean Basin and the Caribbean. *Brucella melitensis* is particularly common in the Mediterranean basin, and it has also been reported from Africa, India and Mexico (CFSPH 2009).The disease has worldwide distribution and importance affecting large number of animal species. Species of *Brucella* are obligate parasites requiring an animal host for maintenance (Glenn and Karen, 2005). Infection occurs through inhalation or ingestion of organisms. A high number of the organism is shed in urine, milk, vaginal discharge, semen and through discharges of birth of infected animals. Caprine and ovine brucellosis caused by the zoonotic bacterium *Brucella melitensis,* is an economically important cause of abortion in small ruminants (Dean et al., 2012; Habtamu et al., 2015). Brucellosis in small ruminants is mainly caused by *Brucella melitensis (B.melitensis)* and *B. ovis* and sporadically by *B.abortus*. This disease is mainly characterized by abortion with the development of yellowish, sticky layers on the placenta in females. In male animals, it causes orchitis and epididymitis, as well as inflammation of the joints and bursa. The consequences of brucellosis in small ruminants are: infertility, a high mortality rate in lambs and kids, mastitis and reduced milk production. According to OIE it annually affects about half million people acquiring brucellosis in the globe (OIE, 2004) It is a zoonotic disease and represents one of the most common public health problems worldwide (Ayman, 2014). However, it is so far a neglected disease in the developing countries. It widely spread in many developing countries and poorly diagnosed in both human and animals due to poor health and diagnostic facilities and limited awareness of the disease among medical practitioners (Kunda et al., 2010). Its diagnosis is complicated by the fact that it shares symptoms with malaria, a common cause of fever and a leading cause of morbidity and mortality in Sub-Saharan Africa, especially in children under 5 years old (Pappas et al., 2006). Sharing of clinical features with malaria and other febrile conditions can likely lead to misdiagnosis and mismanagement of cases and hence

perpetuating human vulnerabilities (Bosilkovski et al., 2009; Jergefa et al., 2009). Therefore, the objectives of this study were:

1- To estimate the seroprevalence of small ruminant brucellosis in the study area
2- To assess risk factor associated with the disease in human and small ruminants in the study area
3- To assess community awareness about zoonotic importance of the disease in the area

Materials and Methods

Description of the Study Area

The study was conducted in Yabello districts of Borenazone of Oromia Regional State, southern Ethiopia. The capital of the zone Yabello is 575 km far from capital city Addis Ababa to south direction. The altitude ranges between 943 and 2,400 meters above sea level with average annual rain fall of 400 to 1100 mm exhibiting a bimodal rainfall (long and short rainy seasons). The long rainy season extends from March to May whereas the short rainy season occurs from mid September to the mid November. The annual temperature varies between 19–42 ^{o}C. The pastoralists usually move with their animals depending on the availability of forage and water (BZPDO, 2014).

The milk is the main source of food in addition to being the source of income particularly during the rainy season when it is produced sufficiently. Borena zone has about 1, 844, 027 cattle, 1, 299, 451 goat, 664, 307 sheep, 216, 131 camels, 414, 021 poultry, 114, 952 donkey, 2, 624 horse and 20, 807 mules (BZPDO, 2014).

Study design and population

Study Design

A cross sectional study was carried out on 283 small ruminants (184 goat and 99 sheep) in Yabello districts from October 2016 to April 2017. Ten peasant associations (PAs) were purposively selected for the study based on small ruminant population. Age determination and history for presence or absence of reproductive problems were obtained from the owners and the animal attendants.

Questionnaire Survey

A questionnaire survey was administered to 120 animal owners/attendant respondents whose animals were included in the study with the help of local language (Afaan Oromo) translator. The questioner was also administered to 6 human health personnel. The information gathered was related to animal risk factors like history of abortion, contact with other ruminants, rearing experience and the pastoralist awareness about brucellosis and its zoonotic importance.

Study population

The study animals were goats and sheep which managed under pastoral production system. The study was conducted in Yabello districts. The PA's was selected purposively depending on small ruminant population. The samples were randomly collected from 20 herds in 10 PAs of the districts. The herd size was determined by the number of sheep and goat.The flock was divided into three groups as; Large, medium and small. Large sized flocks were flocks with animal number greater than 30; medium flock size contained 10 to 30 animals and small herds included herds

with less than 10 animals based on the community herd level grouping.

Sample size

The previous prevalence of sheep and goat brucellosis in the study area was 1.17 and 1.88, respectively (Golo et al., 2013). Therefore using the following formula the number of required animals was calculated.

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

Where: -n= the required sample size, Pexp= expected prevalence/previous prevalence, and d=desired absolute precision

When this calculated by absolute (95%) precision confidence level, the obtained sample sizes were 17 and 28 for sheep and goat, respectively according to the formula of sample size determination in random sampling for infinite population (Thrusfield, 2005). Since the sample sizes obtained by the above mentioned formula were too small, they were increased to 99 and 184 for sheep and Goats, respectively for the present study.

Type of samples and sampling procedures

Serum samples

About 8 ml of blood samples were aseptically collected from the jugular vein of all small ruminants in the district of the study area using disposable needles and plain vacutainer tubes. The collected blood samples were allowed to clot at room temperature. Then, serum was separated from clotted blood by decanting to plastic cryovials. Serum samples were properly labeled and stored at –20 °C for future serological test.

Laboratory techniques

Serological examination

Rose Bengal plate test

All serum samples were initially screened using modified Rose Bengal Plate (25µl:75µl, sera: antigen ratio) Test (RBPT). The antigen used was Rose Bengal antigen, which constitutes a suspension of *B. abortus*. Samples were tested at Yabello regional veterinary center according to the procedures described by Alton *et al*. (1988), the World Organization for Animal Health (OIE, 2004).

Competitive ELISA(c-ELISA)

All serum samples found to be positive by RBPT was submitted to National Animal Health Diagnostic and Investigation Center (NAHDIC) and tested by c-ELISA. The test conducted according to the manufacturer guide lines/SOP.

Data management and analysis

The data regarding community awareness on brucellosis; the ways of the consumption of animal products, the presence and absence of undulant fever, joint problem and other complications were recorded. Additionally, the history of abortion, lactation age, retained placenta, still birth and other suggestive clinical signs of brucellosis was recorded by a structured questionnaire from animal owner/attendants. All data was analyzed using Stata 11 and the $p<0.05$ value was used to determine the significance of different risk factors with sero-positivity and 95% confidence interval (CI) at 5% cut-off value were set for significance.

Results

Laboratory result

Out of 283 (184 Caprine and 99 Ovine) serum samples serially tested by RBPT and c-ELISA; 24 (8.5%) and 23(8.1%) were positive for Rose Bengal Plate test (RBPT) and Competitive Enzyme Linked Immuno Sorbent Assay(c-ELISA), respectively. The overall prevalence of small ruminant brucellosis in the study area was 8.1 % (95% CI: 5.2, 11.9). The species-specific seroprevalence of brucellosis was 9.2 (95% CI: 5.5, 14.4) and 6 (95% CI: 2.3, 12.7) in goats and sheep, respectively (Table 1). A higher prevalence of brucellosis was recorded in goat 9.2 (95% CI: 5.5, 14.4) than in sheep. Highest sero positivity was recorded in herds with more number of animals in the herds with prevalence of 17.3 (95% CI: 9.8, 28.5).

Table 1. Species-specific seroprevalence of Brucellosis in small ruminants.

Species	Total	RBPT			c-ELISA			95 % CI
		Negative	Positive	%	Negative	Positive	%	
Caprine	184	166	18	9.8	167	17	9.2	5.5, 14.4
Ovine	99	93	6	6.1	93	6	6.1	2.3, 12.7
Total	283	259	24	8.5	260	23	8.1	5.2, 11.9

Table 2. The prevalence of small ruminant brucellosis in association with different risk factors.

Factors	Prevalence (%)					
	n	RBPT	c-ELISA			
				95% CI	X^2	P-Value
Retained Fetal Membrane						
Yes	9	3 (40.0	3 (33.3)	4.2, 10.6	14.1	0.004
No	262	19 (7.3)	18 (6.9)	4.1, 10.1		
Abortion history						
Yes	29	2 (6.9)	1 (3.4)	0.1, 17.8	0.8	0.35
No	242	20 (8.7)	20 (8.3)	5.1, 12.2		
Still birth						
Yes	3	2 (66.7)	1 (3.4)	9.4, 99.2	14.7	0.000
No	268	19 (7.1)	20 (8.3)	4.3, 10.8		
Age						
Adult	272	24 (8.8)	23 (8.1)	5.4, 12.4	1.01	0.310
Young	11	0	0	0.2, 41.3		
Sex						
Female	271	22 (8.1)	21 (7.7)	4.8, 11.6	1.22	0.260
Male	12	2 (16.7)	2 (16.7)	2.1, 48.4		
Herd size						
Large	75	13 (17.3)	13 (17.3)	9.8, 28,5	13.85	0.001
Medium	127	10 (7.9)	9 (7.1)	3.3, 13.02		
Small	81	1 (1.2)	1 (1.2)	0.03, 6.7		

A statistically significant (X^2= 13.85, P= 0.001) variation on the prevalence of brucellosis was recorded between the herd size in small ruminants in this study. The highest prevalence recorded in large-sized herds (17.3, 95% CI: 3.3, 13.02) compared to the medium-sized herds (7.9, 95% CI: 9.8, 28,5) in small ruminants. Furthermore, there also was statistically significant (p< 0.05) difference on prevalence of brucellosis between ewes with retained fetal membrane and those without retained fetal membran es as well as with ewes having still birth with ewe delivering their lambs normally (Table 2).

Questioners result

The questioner was administered to a total of 120 pastoralists within 10 peasant associations (PAs), 20 Olla of three districts and 6 human health personnel.

The questioner results revealed the existence of the assumed risk factors associated with brucellosis in the area. These consisted of handling aborted fetus and its materials (placenta) by bare hand; and consuming blood and raw milk. Since, 120 (95.3%) pastoralists consumed raw milk and 114 (90.5%) handled the aborted fetus by bare hand, it is logic to conclude that they could be the main route of acquiring the disease.

The community animal health workers (CAHWs) and human health professionals working in health post were aware of the disease in the study area. Though, they know about the disease, they didn't consider brucellosis while diagnosing patients with suggestive clinical sign of disease. (Table 3). This could be due to lack of diagnostic equipment and kits, less attention given to the disease and the absence of coordination on the required information between human and animal professionals on zoonotic diseases for effective control and prevention.

Table 3. Associated risk factors of brucellosis in human and the community awareness.

Risk factors	**No.of respondents (%)**
Know about Brucellosis	
Yes	14 (11.1%)
No	112 (88.9%)
Use protective while supporting animals during parturition	
Yes	10 (7.9%)
No	116 (92.1%)
Consume raw Animal products (Milk, Blood or Meat)	
Yes	120 (95.3%)
No	6 (4.7%)
Handle aborted fetus and retained placenta by bare hand	
Yes	114 (90.5%)
No	12 (9.5%)

Children and females are the house hold members who are responsible in caring small ruminants. When they come across to the aborted animals they keep and handle the aborted materials by bare hand. Children and females are most at risk group in house hold in acquiring brucellosis from small ruminants.

Discussion

Ethiopia is one of the developing countries in Africa and holds the 1st spot in the rankings of livestock number in the continent. There is a huge population of livestock and a very high portion of human population lives in rural areas. The investigation of the status of brucellosis both in livestock and humans is of principal importance to protect public and animal health. Small ruminants are main source of income for poor communities in developing counties. The community daily life and livelihood is dependent on animal and animal products which allow easy transmission of zoonotic disease from animal to human. Brucellosis is one of a disease which can affect health of human who has close contact with animals and has feeding habit of raw animal products. As in the other developing countries, brucellosis has not been brought under control in Ethiopian livestock, which might be due to trans-boundary animal movement, information gap about the disease both in human and animal health professionals, absence of strategic plan to prevent/control brucellosis in animal and human, lack of awareness of the disease among pastoralists, farmers, and the general public (Boukary et al., 2013). The current study indicated a serological evidence of brucellosis in small ruminant, information gap on the existence of disease both in human and animal health professionals; and lack of community awareness about zoonotic importance of the disease.

This study showed that the overall seroprevalence of brucellosis in small ruminants in Borena zone Oromia regional state, Ethiopia was 8.1% out of which 9.2% and 6.1% belonged to the goat and sheep, respectively. This sum is considerably higher than reported by Dabasa et al. (2013) in Borena zone, Oromia region with prevalence of 1.17 and 1.88% in sheep and goat, respectively; and by Sintayehu et al. (2015) with prevalence of 3.3% in small ruminant brucellosis. This difference between two study conducted in the same area may be explained as the variation in the serological tests used. The higher sero positivity was recorded in goat than in sheep in the present study which is in agreement with the study conducted by other research groups (Dabasa et al., 2013; Tsehay et al., 2014; Bezabih and Bulto, 2015; Wedajo et al., 2015).

This study revealed that the majority of pastoralists encountering issues such as abortion in their animals were not aware of the zoonotic importance of the diseases. They consume raw milk and animal blood, handle aborted fetus with bare hand without any protective clothing. Consequently, there is high risk of human brucellosis in the area. This outcome is in agreement with the study conducted by Habtamu et al. (2015). Additionally, certain pastoralists complained about some suggestive clinical sign of Brucellosis like undulant fever, joint problems and back pain which is also in agreement with the results reported by Bekele et al. (2011). Pastoralist's daily life is linked with livestock production and their close contact with animal and animal product is obvious. This permits the spread of zoonotic diseases that are transmissible from animal to human. Animals unavoidably contaminate their

environment during abortion or calving with discharges which might be the source of the infection to other animals. Humans are often infected through contact with the infected animals, aborted materials and vaginal discharges (Mgawe et al., 2012).

In this study, A significantly (P=0.004) higher seroprevalence of brucellosis in small ruminants (ewes) having a history of retained fetal membranes was recorded in comparison to those without these problems in this study. However, there were no statistically differences between ewes with abortion history and with no problem of abortion. This could be due to the outbreak of an unknown-caused abortion in 2015/2016 in the study area. Generally, the disease prevalence in combination with the lack of community awareness about zoonotic importance of the disease and close contact of pastoralists with animals will create a high risk of human brucellosis especially in children and females who are responsible for caring small ruminants.

This study revealed that brucellosis is prevalent and well-established infection among goats and sheep in the study area. Sero-prevalence of brucellosis was higher in goats than sheep; and in animals within dense and large herd size. It could be concluded that the positive animal could be a potential risk for both animals and humans infection in the area. In addition, communities in the study area had no awareness about zoonotic importance of the disease. This could increase the risk of human brucellosis. Despite the existence of a high risk of human brucellosis, physicians are not considering brucellosis while diagnosing patients with suggestive clinical signs of brucellosis. Therefore, we recommend that:

1. National brucellosis control and prevention strategy should be developed and applied
2. Community should be educated about zoonotic importance of the disease
3. Human and animal health professionals; have to work together on zoonotic diseases like brucellosis for successful prevention and control of the disease both in human and animals.

Acknowledgement

The authors are thankful to Yabello Regional Veterinary Laboratory for their financial support for this study. Our thanks go to NAHDIC (National Animal Health Diagnostic and Investigation Center) for providing kits for c-ELISA test. We also acknowledge all Yabello Regional Veterinary Laboratory and NAHDIC Lab technologist who participated in this research.

References

Alton G.G., Jones L.M., Angus E.R. and Verger J.M. (1988). Techniques for the brucellosis laboratory. 1st (Ed). Paris. pp. 22–63.

Ayman E. (2014). Evaluation of Diagnostic Techniques and Antimicrobial Resistance of *Brucella* spp. Isolated from Blood Serum of Camels and Camel Ranchers. *Journal of Microbiology Research*, 4(2), pp. 104-111.

Bekele M., Demelash B., Fekadu N., Tesfaye R., Kassahun A. and Eystein S. (2011). Cattle brucellosis in traditional livestock husbandry practice in Southern and Eastern Ethiopia, and its zoonotic implication. *Acta Veterinaria Scandinavica Journal*, 53, pp. 24.

Bezabih M.K. and Bulto W.C. (2015). Sero prevalence of small ruminant brucellosis in werer agricultural research afar region, Northern Ethiopia. *Academia Journal of Microbiology Research*, 3(2), pp. 031-035.

BZPDO. (2014). Livestock data in borena zone, Borena Zone pastoral Development office. Yabello, Ethiopia.

Bosilkovski M., Dimzova M. and Grozdanovsk K. (2009). Natural History of Brucellosis in an endemic Region in different time Periods. *Acta clinica croatica*, 48, pp. 41-45.

Boukary A.R., Saegerman C., Abatih E., Fretin D., AlambédjiBada R., Reginald De D., Halimatou A.H., Alhassane Y. and Eric T. (2013). Sero prevalence and Potential Risk Factors for *Brucella* Spp. Infection in Traditional Cattle, Sheep and Goats Reared in Urban, Peri urban and Rural Areas of Niger. *PLoS ONE*, 8, pp. e83175.

CSA. (2011). Central Statistical Agency Ethiopia, Addis Ababa, Ethiopia.

Center for Food Security and Public Health (CFSPH). (2009). Brucellosis. Available at: www.cfsph.iastate.edu/Factsheets/pdfs/brucellosis.pdf.

Cutler S.J., Whatmore A.M. and Commander N.J. (2005). Brucellosis new aspects of an old disease. *Journal of Apply Microbiology*, 98, pp. 1270-1281.

Dabasa G., Tefera M. and Addis M. (2013).Small Ruminant Brucellosis: Serological Survey in Yabello District, Ethiopia. *Asian Journal of Animal Science*, 7(1), pp. 14-21.

Dean A.S., Crump L., Greter H., Schelling E. and Zinsstag J. (2012). Global burden of human brucellosis: a systematic review of disease frequency. *PLoS Neglected Tropical Disease*, 6, pp. e1865.

Glenn J.S. and Karen W.P. (2005). Veterinary Microbiology: Bacterial and Fungal agents of animal diseases, 1st Edition, pp.200-203.

Habtamu T.T., Richard B., Dana H. and Kassaw A.T. (2015). Camel Brucellosis: Its Public Health and Economic Impact in Pastoralists, Mehoni District, Southeastern Tigray, Ethiopia. *Journal of Microbiology Research*, 5, pp. 149-156.

Holt H., Eltholth M., Hegazy Y., El-Tras W., Tayel A. and Guitian J. (2011). *Brucella spp*. infection in large ruminants in anendemic area of Egypt, Cross-sectional study investigating sero prevalence, risk factors and livestock owner's knowledge, attitudes and practices (KAPs). *BMC Public Health Journal*, 11, pp. 341-350.

International Livestock Research Institute (ILRI). (2006). Domestic animal genetic resources information system (DAGRIS). http://www.dagris.info.

Jergefa T., Kelay B., Bekana M., Teshale S., Gustafson H. and Kindahl H. (2009). Epidemiological study of bovine brucellosis in three agro-ecological

areas of central Oromiya, Ethiopia. *International office of Epizootic*, 28 (3), pp. 933-943.

Kunda J., Fitzpatrick J., French N., Kazwala R.R., Kambarage D.M., Mfinanga G.S., MacMillan, A. and Cleaveland S. (2010). Quantifying Risk Factors for Human Brucellosis in Rural Northern Tanzania. *PLoS ONE*, 5(4), pp. e9968.

Mgawe P., Borgerhoff Mulder M., Caro T., Martin A. and Kiffner C. (2012). Factors affecting bush meat consumption in the Katavi-Rukwa ecosystem of Tanzania. *Tropical Conservation Science*, 5(4), pp. 446–62.

OIE. (2004). World organization for animal health.Bovine brucellosis.In: Manual of standard for diagnostic tests and vaccines, 5th edition, Paris, pp. 242-262.

Pappas G., Papadimitriou P., Akriditis N., Christou L. and Tsianos E.V. (2006). The new global map of human brucellosis. *Lancet Infectious Diseases*, 6: pp. 91-9.

Pastoralist Forum Ethiopia (PFE). (2004). Background to the Ethiopian livestock industry. In Proc. 3rd National Conference on Pastoral Development in Ethiopia: pastoralist and sustainable pastoral development, 23-24 December PFE, Addis Ababa, Ethiopia, pp. 78-79.

Sintayehu G., Melesse B., Abayneh A., Sintayehu A., Melaku S., Alehegne W., Mesfin S., De Blas I., Casal J., Allepuz A., Martin-Valls G., Africa T. and Abera J. (2015). Epidemiological survey of brucellosis in sheep and goats in selected pastoral and agro-pastoral lowlands of Ethiopia, *Revue scientifique et technique (International Office of Epizootics)*, 34 (3), pp. 881-893.

Tsehay H., Getachew G., Morka A., Tadesse B. and Eyob H. (2014). Sero prevalence of brucellosis in small ruminants in pastoral areas of Oromia and Somali regional states. *Ethiopia Journal of Veterinary Medicine and Animal Health*, 6(11), pp. 289-294.

Thrusfield M. (2005). Veterinary Epidemiology.3 ed. Oxford: Blackwell Science Ltd. pp. 228-246.

Wedajo M.T., Fekadu R.G., Tefera Y.M., Yalew T.A., Alemayehu L.B. and Abadi A.R. (2015). Sero prevalence of small ruminant brucellosis and its effect on reproduction at Tellalak District of Afar region, Ethiopia. *Journal of Veterinary Medicine and Animal Health*, 7(4), pp. 111-116.