

Provided for non-commercial research and education use.

Not for reproduction, distribution or commercial use.



This article was published in an Sjournals journal. The attached copy is furnished to the author for non-commercial research and education use, including for instruction at the authors institution, sharing with colleagues and providing to institution administration.

Other uses, including reproduction and distribution, or selling or licensing copied, or posting to personal, institutional or third party websites are prohibited.

In most cases, authors are permitted to post their version of the article (e.g. in Word or Tex form) to their personal website or institutional repository. Authors requiring further information regarding Sjournals's archiving and manuscript policies encouraged to visit:

<http://www.sjournals.com>

© 2017 Sjournals Publishing Company

Contents lists available at Sjournals
Scientific Journal of Veterinary Advances

Journal homepage: www.Sjournals.com



Original article

***Fasciola* infection prevalence and financial loss due to liver condemnation in cattle slaughtered at Wolaita Sodo municipal abattoir, southern Ethiopia**

Semayat Oyda^a, Desie Sheferaw^{b,*}, Kassaye Aragaw^b

^a*MoLFD, South Nations, Nationalities and Peoples Region (SNNPRS), Dawuro Zone, Loma, Ethiopia.*

^b*Hawassa University School of Veterinary Medicine, P.O. Box 05, Hawassa, Ethiopia.*

*Corresponding author: mereba480@gmail.com

ARTICLE INFO

Article history,

Received 12 October 2017

Accepted 13 November 2017

Available online 20 November 2017

iThenticate screening 14 October 2017

English editing 12 November 2017

Quality control 19 November 2017

Keywords,

Cattle

Fasciolosis

Fasciola gigantica

F. hepatica

Liver condemnation

Ethiopia

ABSTRACT

A cross-sectional study was conducted at Wolaita Sodo municipality abattoir during November 2010 to April 2011 with the objectives to estimate the prevalence of *Fasciola* infection in slaughtered cattle and to assess the associated financial loss due to liver condemnation. Livers and feces of a total of 415 randomly selected cattle slaughtered at the abattoir were examined for *Fasciola* and their ova, respectively. Of the 415 livers and fecal sample examined, 127 (30.6%) and 103 (24.8%) were positive, respectively. Both *Fasciola hepatica* and *F. gigantica* were identified during the study. However *F. gigantica* was more prevalent (27.0%) than *F. hepatica* (3.6%) ($P < 0.05$). There was strong association ($P < 0.001$) between animal origin and *Fasciola* prevalence. *Fasciola* prevalence was higher in cattle from low-land (46.0%) areas compared to cattle from mid altitude areas (18.0%). Comparison of coprological examination with postmortem examination by taking the latter as gold standard, demonstrated almost perfect agreement between the two (*Kappa* statistics= 0.86). The annual financial loss due to liver condemnation associated with liver flukes at the abattoir was estimated to be 115,362 Ethiopian Birr. It is concluded that fasciolosis is prevalent in areas which supply slaughter cattle to Wolaita Sodo municipal abattoir and the associated financial loss due to liver condemnation is considerable.

© 2017 Sjournals. All rights reserved.

1. Introduction

Fasciolosis is one of the most economically important livestock diseases in Ethiopia hampering productivity and causing mortality (Njau et al., 1988; Ngategize et al., 1993; Abunna et al., 2010). Fasciolosis is caused by infection with trematodes of the genus *Fasciola*, which are commonly known as liver flukes. The two most commonly known species are *Fasciola hepatica* and *F. gigantica*. *Fasciola hepatica* has a worldwide distribution, but is predominately found in temperate regions, whereas *F. gigantica* is mainly found in the tropical regions. The most important definitive hosts are cattle and sheep; however certain other mammals, including humans, may be infected (Andrews, 1999). It is economically important disease that causes reduction in milk production and quality (Urquhart et al., 1996; Bardhan et al., 2014), leads to poor weight gain (Ross, 1970; Hope-Cawdery et al., 1977), reduces reproductive performance (Elliott et al., 2015), causes liver condemnation at slaughter (Ogunrinade and Ogunrinade, 1980; Berhe et al., 2009; Abebe et al., 2010; Abunna et al., 2010) and causes significant mortality (Njau et al., 1988) in ruminant livestock.

Prevalence of *Fasciola* infection has been reported from various parts of the country (Ameni et al., 2001; Abebe et al., 2010; Fromsa et al., 2010; Aragaw et al., 2012; Belay et al., 2012; Aregay et al., 2013; Petros et al., 2013; Sisay et al., 2014; Alemu and Abebe, 2015; Girmay et al., 2015; Gadisa and Addis, 2016; Tengase et al., 2016; Taye et al., 2016; Yusuf et al., 2016; Meshesha and Tesfaye, 2017). Several studies from different parts of the country also demonstrated the considerable financial loss incurred by *Fasciola* infection due to liver condemnation at slaughter (Berhe et al., 2009; Abebe et al., 2010; Abunna et al., 2010). Although estimates of economic losses due to decreased production and reproductive performance are scarce it is possible to assume that there could be huge economic loss incurred to livestock productivity in the country based on the available literature on negative effect of the parasite on animal health and productivity (Ross, 1970; Hope-Cawdery et al., 1977; Njau et al., 1988; Ngategize et al., 1993; Urquhart et al., 1996; Elliott et al., 2015) and the high prevalence and wide distribution of *Fasciola* infection in the country (Yilma and Malone, 1998). Despite the huge economic losses incurred and the widespread distribution of fasciolosis in the country, significant control measures have not yet been developed at regional and national levels (Yilma and Malone, 1998). Therefore, the objectives of this study were to estimate the prevalence of *Fasciola* infection, and assess the associated financial loss due to liver condemnation in cattle slaughtered at Wolaita Sodo municipal abattoir.

2. Materials and methods

2.1. Study area and animals

The study was conducted on 415 cattle slaughtered at Wolaita Sodo municipal abattoir from November 2010 to April 2011. The sources of cattle slaughtered in the abattoir were midland (Dalbo, Boditi, Areka, Goffa and Dawuro) and wet lowland (South Omo, Humbo, Halaba, Hobicha and Arba-Minch) areas in and around Wolaita zone. All cattle included in the study, except five, were male and all of them indigenous zebu cattle. The midland and lowland areas, from which the slaughter cattle originated, are characterized by sub-moist cool and sub-moist warm climate, respectively. The altitude of the source areas range from 1500 to 2500 and 500 to 1500 meters above sea level for midland and lowland, respectively (MoA, 2000). About 6500 cattle are slaughtered at the abattoir annually.

2.2. Study design, sampling method and sample size

The study was cross-sectional study whereby the study animals were selected from the slaughter line using systematic random sampling. The sample size required was computed according to Thrusfield (2005), using 14% expected prevalence (Abunna et al., 2010), 95% level of confidence and 5% desired level of precision, which gives a sample size of 185. But in order to improve precision more than double of the computed sample size (415) was used during the study. Information regarding origin of the animals was recorded during ante-mortem examination. Identification number was given to each animal presented to the abattoir to identify the animals in the process of slaughtering.

2.3. Study methods

The study involved physical examination of liver for presence of liver flukes at the abattoir and microscopic examination of fecal samples collected from the rectum of the same animals (with liver examination) after evisceration for *Fasciola* eggs.

2.4. Coprological examination

Fecal samples were collected directly from the rectum into clean screw capped universal sample bottles. The samples, labeled with the ID numbers of the animals, were immediately transported to Sodo Regional Veterinary Laboratory for examination on the date of collection following the standard fecal sedimentation procedure described by Urquhart et al. (1996) for *Fasciola* eggs.

2.5. Liver examination

During meat inspection, livers from previously identified animals were carefully examined for liver flukes as described by Herenda et al. (2000). The examination involved inspection and palpation of the entire liver, which was followed by transverse incision of the organ across the thin left lobe in order to confirm the presence of the worms (Herenda et al., 2000).

2.6. Estimation of direct monetary loss

The direct annual loss from liver condemnation was assessed by considering the overall prevalence of fasciolosis obtained from this study, the total number of annually slaughtered cattle in the abattoir and the retail market price of liver. The mean annual number of cattle slaughtered at the abattoir was estimated using the respective figures for the two years immediately preceding (i.e. 2008 and 2009) the study, while the average retail market price of liver was obtained from butchers in Sodo town. During the study period, the average price of a liver was 78 Ethiopian Birr (ETB). Based on this information the following formula was used to compute the direct monetary loss per annum.

$$ALC = MCS \times MLC \times P$$

Where, ALC= Annual loss from liver condemnation; MCS= Mean annual cattle slaughtered at Wolaita Sodo municipal abattoir; MLC= Average price of a liver; and P= Postmortem prevalence of fasciolosis.

2.7. Data management and analysis

All collected data were entered into Microsoft Excel spread sheet and coded. Then, the data were summarized by descriptive statistics like mean and proportion. The prevalence of fasciolosis was calculated by dividing the number of cattle harboring *Fasciola* species by the number of cattle examined. Pearson's chi-square was used to measure the association between the prevalence of fasciolosis and the potential risk factor -animal origin. The prevalence of *Fasciola* observed through coprological and postmortem examination was compared by using Kappa statistics.

3. Results and discussion

3.1. Coprological examination

From a total of 415 fecal samples examined 103 (24.9%) were found to be positive for *Fasciola* eggs. Fecal examination revealed that 32 (14.0%) animals from midland and 71 (38.0%) animals from lowland were positive for *Fasciola* eggs (Table 1).

Table 1
Coprological prevalence of *Fasciola* in the two agro-ecologies (n=415).

Site	No examined	No (%) positive	95% CI	χ^2	P-Value
Midland	228	32 (14.0)	9.5 - 18.6	31.54	0.000
Lowland	187	71 (38.0)	31.0 - 45.0		
Total	415	103 (24.8)	20.6 - 29.0		

3.2. Postmortem examination

Of 415 cattle liver examined during the study 127 (30.6%) were found infected with *Fasciola*. The two species of *Fasciola*, *F. hepatica* and *F. gigantica*, most commonly implicated as the etiological agents of fasciolosis were found infecting cattle slaughtered at Sodo abattoir (Table 2).

Table 2

Postmortem prevalence of *Fasciola* species in cattle slaughtered at Wolaita Sodo abattoir (n=415).

Species	No. (%) positive	95% CI	χ^2	P-Value
<i>F. hepatica</i>	15 (3.6%)	1.8 - 5.4		
<i>F. gigantica</i>	112 (27.0%)	22.7 - 31.3	5.75	0.016
Total	127 (30.6%)			

Table 3 shows the prevalence of liver fluke infection obtained through postmortem examination of the livers of the study animals in relation to their origin. Animals which originated from lowland areas were found to be more affected by liver fluke (46.0%) than cattle from mid altitude areas (18.0%) ($P < 0.001$).

Table 1

Association between animals' origin and postmortem *Fasciola* prevalence.

Origin	No examined	No (%) affected	95% CI	χ^2	P-Value
Mid altitude	228	41 (18.0)	13.0 - 23.0		
Lowland	187	86 (46.0)	38.8 - 53.2	37.95	0.000
Total	415	127 (30.6)			

Fasciola gigantica was the predominant species found infecting the liver of the study animals. This species was the predominant liver fluke in slaughtered cattle from both mid and lowland areas.

3.3. Agreement of coprological examination result with postmortem

The result of coprological examination using sedimentation procedure was compared with postmortem examination result. Accordingly, there was almost perfect agreement between coprological and postmortem results (*Kappa* statistic= 0.86); and the sensitivity and specificity of the coprological test was calculated to be 81.1 % and 100 %, respectively (Table 4).

Table 4

Test agreement between fecal and postmortem examination.

Type of examination		Postmortem examination		
		Positive	Negative	Total
Coprological examination	Positive	103	0	103
	Negative	24	288	312
	Total	127	288	415

Kappa= 0.86

3.4. Annual financial loss

Annual financial loss from liver condemnation due to *Fasciola* infection was estimated by taking into consideration the annual average number of cattle slaughtered, postmortem prevalence of fasciolosis (30.6%) and retail price of liver. The annual average number of cattle slaughtered at Wolaita Sodo abattoir was computed from total slaughter of cattle in the last two years preceding the study, i.e. 2008 and 2009. Accordingly, the annual average slaughtered cattle were found to be about 6,500 heads. The retail price of liver during the study period in Wolaita Sodo was 78 Ethiopian birr (ETB). Therefore, the financial loss associated with liver condemnation was calculated by multiplying the annual average number of cattle slaughtered at the abattoir (6,500) by the postmortem prevalence of *Fasciola* species (0.306) multiplied by the average retail price of liver (78 ETB).

Accordingly, the estimated annual financial loss due to liver condemnation at Wolaita Sodo municipality abattoir was about 155,142 ETB.

The 30.6% postmortem prevalence of *Fasciola* infection observed in the current study is within the range of 14.0-90.7% for slaughtered cattle in Ethiopia (Yilma and Mesfin, 2000; Berhe et al., 2009; Abebe et al., 2010; Abunna et al., 2010; Fromsa et al., 2011; Aragaw et al., 2012; Abunna and Hordofa, 2013), and is comparable to results of several studies from different parts of the country (Berhe et al., 2009; Abebe et al., 2010; Belay et al., 2012; Chakiso et al., 2014; Meshesha and Tesfaye, 2017). However, it was much lower compared to the 90.7% liver infection reported from northern Ethiopia (Yilma and Mesfin, 2000) and higher than the 14.0% reported from the same abattoir with our study (Abunna et al., 2010). The variation could be due to differences in climatic and ecological conditions such as altitude, rainfall, temperature and livestock management system among areas supplying slaughter cattle to respective abattoirs (Yilma and Mesfin, 2000) and variation in weather condition, especially rainfall, among the study years (Malone and Yilma, 1999; Mungube et al., 2006). The higher prevalence of *Fasciola* in cattle from lowland (sub-moist warm) areas may be explained by presence of permanent water bodies in the lowland areas supplying the abattoir with slaughter animals. Arba Minch and South Omo, which are among the lowland areas, are home to Lake Abaya and Chamo, and the River Omo which floods vast area during the rainy season, respectively.

The prevalence of *F. gigantica* (27.7%) was significantly ($\chi^2=5.75$, $P<0.05$) higher than *F. hepatica* (3.6%) (Table 2). Similar findings were reported from the same abattoir (Abunna et al., 2010) and from western Ethiopia (Fromsa et al., 2011). However, our finding is in contrast to several reports from other abattoirs from different parts of the country which recorded *F. hepatica* as a predominant species (Anberber et al., 2014; Yilma and Mesfin, 2000; Berhe et al., 2009; Abebe et al., 2010; Aragaw et al., 2012; Belay et al., 2012; Chakiso et al., 2014; Taye et al., 2016; Meshesha and Tesfaye, 2017). On the other hand, only *F. gigantica* was reported in several studies from many African countries (Keyyu et al., 2006; Mungube et al., 2006; Jean-Richard et al., 2014). The variation may be explained by the difference in the prevailing agro-climatic conditions among areas supplying slaughter cattle for the respective study abattoirs. Under Ethiopian condition sustainable transmission of *F. hepatica* is likely to occur in highland environment with altitude over 1200 m a.s.l., while infection transmission of *F. gigantica* is likely to occur in areas with altitude below 1800 m a.s.l.; with possibility of mixed infections between 1200 and 1800 m a.s.l. (Yilma and Malone, 1998), owing to different environmental requirements, of the snail intermediate hosts and larval stages in the snail, of the two *Fasciola* species (Spithill et al., 1999). The high proportional prevalence of *F. gigantica* in our study is in line with the higher prevalence of *Fasciola* we observed in cattle originated from lowland areas. *Fasciola gigantica* is a tropical and subtropical parasite which requires wet and relatively high ambient temperature to complete its life cycle (Taylor et al., 2007).

The coprological examination result was compared to the postmortem examination by taking the later as a gold standard. According to Thrusfield (2005), this result (*Kappa* statistics= 0.86) suggested that there was almost perfect agreement between the two methods of examination at the abattoir. The finding suggests that, fecal examination with sedimentation technique is reliable in the diagnosis of chronic fasciolosis; with the sensitivity and specificity of 81.1% and 100%, respectively. This finding is in a general agreement with the report of Tengase et al. (2016) and Alemu and Abebe (2015). The estimated annual financial loss due to liver condemnation in the study abattoir was about 155,142 ETB. The incurred economic loss could be much more than this value if the indirect losses such as reduction in the carcass weight and milk production were computed and included.

In conclusion, the present study revealed a relatively high prevalence of fasciolosis in cattle slaughtered at Wolaita Sodo municipal abattoir and proved the existence of the two species of *Fasciola* in areas supplying slaughter cattle to the abattoir; although *F. gigantica* was the predominant species. The study also demonstrated that fasciolosis continued to cause significant financial loss due to liver condemnation at the slaughterhouse. There is a need to develop agro-ecological based strategies to mitigate the losses incurred by *Fasciola* infection in livestock in the country.

Acknowledgements

We are grateful to Wolaita Sodo abattoir workers and the municipal for their unreserved help during data collection.

References

- Abebe, R., Abunna, F., Berhane, M., Mekuria, S., Megersa, B., Regassa, A., 2010. Fasciolosis: Prevalence, financial losses due to liver condemnation and evaluation of a simple sedimentation diagnostic technique in cattle slaughtered at Hawassa Municipal abattoir, southern Ethiopia. *Ethiop. Vet. J.*, 14(1), 39-52.
- Abunna, F., Asfaw, L., Megersa, B., Regassa, A., 2010. Bovine fasciolosis: Coprological, abattoir survey and its economic impact due to liver condemnation at Sodo municipal abattoir, southern Ethiopia. *Trop. Anim. Health Prod.*, 42(2), 289-292.
- Abunna, F., Hordofa, D., 2013. Major causes of organ condemnation for cattle and its financial impact at Wolaita Soddo Municipality abattoir, southern Ethiopia. *Glob. Vet.*, 11(6), 730-734.
- Alemu, A., Abebe, B., 2015. Fasciolosis: Prevalence, evaluation of flotation and simple sedimentation diagnostic techniques and monetary loss due to liver condemnation in cattle slaughtered at Wolaita Soddo municipal abattoir. *Food Sci. Qual. Manag.*, 43, 84-97.
- Ameni, G., Erko, B., Bogale, T., 2001. Preliminary study on the major bovine trematode infection around Kemissie, northeastern Ethiopia and treatment trial with praziquantel. *Bull. Anim. Health Prod. Afr.*, 49, 62-67.
- Anberber, M.Z., Gurmesa, M., Tesfaye, T., 2014. Economic significance of fasciolosis at Mettu municipal abattoir, southwest Ethiopia. *J. Adv. Vet. Res.*, 4(2), 53-59.
- Andrews, S.J., 1999. The life cycle of *Fasciola hepatica*. In: Dalton, J.P. (Ed.), *Fasciolosis*. CABI Publishing, UK, 1-29.
- Aragaw, K., Negus, Y., Denbarga, Y., Sheferaw, D., 2012. Fasciolosis in slaughtered cattle in Addis Ababa abattoir, Ethiopia. *Glob. Vet.*, 8(2), 115-118.
- Aregay, F., Bekele, J., Ferede, Y., Hailemelekot, M., 2013. Study on the prevalence of bovine fasciolosis in and around Bahir Dar, Ethiopia. *Ethiop. Vet. J.*, 17(1), 1-11.
- Bardhan, D., Kumar, R.R., Nigam, S., Mishra, H., Bhoj, S., 2014. Estimation of milk losses due to fasciolosis in Uttarakhand. *Agr. Econ. Res. Rev.*, 27(2), 281-288.
- Belay, E., Molla, W., Amare, A., 2012. Prevalence and economic losses of bovine fasciolosis in Dessie municipal abattoir, south Wollo zone, Ethiopia. *Eur. J. Biol. Sci.*, 4(2), 53-59.
- Berhe, G., Berhane, K., Tadesse, G., 2009. Prevalence and economic significance of fasciolosis in cattle in Mekelle area of Ethiopia. *Trop. Anim. Health Prod.*, 41(7), 1503-1504.
- Central Statistical Agency (CSA), 2012. Report on livestock and livestock characteristics. Agricultural Sample Survey, 2011/12, Federal Democratic Republic of Ethiopia, Central Statistical Authority, Addis Ababa, Ethiopia, 2, 4-165.
- Chakiso, B., Menkir, S., Desta, M., 2014. On farm study of bovine fasciolosis in Lemo district and its economic loss due to liver condemnation at Hossana municipal abattoir, southern Ethiopia. *Int. J. Curr. Microbiol. App. Sci.*, 3(4), 1122-1132.
- Elliott, T.P., Kelley, J.M., Rawlin, G., Spithill, T.W., 2015. High prevalence of fasciolosis and evaluation of drug efficacy against *Fasciola hepatica* in dairy cattle in the Maffra and Bairnsdale districts of Gippsland, Victoria, Australia. *Vet. Parasitol.*, 209(1-2), 117-124.
- Fromsa, A., Meharenet, B., Mekibib, B., 2011. Major trematode infection of cattle slaughtered at Jimma municipality abattoir and the occurrence of the intermediate hosts in selected water bodies of the zone. *J. Anim. Vet. Adv.*, 10(12), 1592-1597.
- Gadisa, B., Addis, M., 2016. The abattoir prevalence and monetary loss of fasciolosis and Hydatidosis among apparently healthy slaughtered cattle at Asella town, Ethiopia. *World Appl. Sci. J.*, 34(7), 897-904.
- Herenda, D., Chambers, P.G., Ettriqui, A., Seneviratna, P., da Silva, T.J.P., 2000. Manual on meat inspection for developing countries. FAO animal production and health paper 119, Rome, Italy, 335p.
- Hope-Cawdery, M.J., Strickland, K.L., Conway, A., Crowe, P.J., 1977. Production effects of liver fluke in cattle. I. The effects of infection on live weight gain, food intake and food conversion efficiency in beef cattle. *Br. Vet. J.*, 133, 145-159.
- Jean-Richard, V., Crump, L., Abicho, A.A., Nare, N.B., Greter, H., Hattendorf, J., Schelling, E., Zinsstag, J., 2014. Prevalence of *Fasciola gigantica* infection in slaughtered animals in south-eastern Lake Chad area in relation to husbandry practices and seasonal water levels. *BMC Vet. Res.*, 10, 81.
- Keyyu, J.D., Kassulku, K.K., Msalilwa, L.P., Monrad, J., Kyvsgaard, N.C., 2006. Cross-sectional prevalence of helminth infection in cattle on traditional, small-scale and large-scale dairy farms in Iringa district, Tanzania. *Vet. Res. Commun.*, 30(1), 45-55.

- Malone, J.B., Yilma, J.M., 1999. Predicting outbreaks of fasciolosis: From Ollerenshaw to satellites. In: Dalton, J.P. (Ed.), Fasciolosis, CABI Publishing, UK, 5, 151-183.
- Meshesha, M., Tesfaye, W., 2017. Prevalence of fasciolosis in cattle slaughtered at Hosanna municipal abattoir, southern Ethiopia. *Int. J. Adv. Res. Biol. Sci.*, 4(2), 40-46.
- MoA, 2000. Agroecological Zonations of Ethiopia. Addis Ababa, Ethiopia.
- Mungube, E.O., Bauni, S.M., Tenhagen, B.A., Wamae, L.W., Nginyi, J.M., Mugambi, J.M., 2006. The prevalence and economic significance of *Fasciola gigantica* and *Stilesia hepatica* in slaughtered animals in the semi-arid coastal Kenya. *Trop. Anim. Health Prod.*, 38, 475-483.
- Ngategize, P.K., Bekele, T., Tilahun, G., 1993. Financial losses caused by ovine fasciolosis in the Ethiopian highlands. *Trop. Anim. Health Prod.*, 25, 155-161.
- Njau, B.C., Kasali, O.B., Scholtrns, R.G., Mesfin, D., 1988. Review of sheep mortality in Ethiopia highlands, 1982-86. *ILCA Bulletin*, 31, 19-22.
- Ogunrinade, A., Ogunrinade, B.I., 1980. Economic importance of Fascioliasis in Nigeria. *Trop. Anim. Health Prod.*, 12, 155-160.
- Petros, A., Kebede, A., Wolde, A., 2013. Prevalence and economic significance of bovine fasciolosis in Nekemte municipal abattoir. *J. Vet. Med. Anim. Health*, 5(8), 202-205.
- Ross, J.G., 1970. The economics of *Fasciola hepatica* infections in cattle. *Br. Vet. J.*, 126(4), xiii-xv.
- Sisay, A., Takele, B., Menda, S., 2014. Prevalence of bovine fasciolosis and economic loss due to liver condemnation at Debre Markos municipal abattoir, northern Ethiopia. *Sci. J. Vet. Adv.*, 3(12), 113-122.
- Spithill, T.W., Smooker, P.M., Copeman, D.B., 1999. *Fasciola gigantica*: Epidemiology, control, immunology and molecular biology. In: Dalton, J.P. (Ed.), Fasciolosis. CABI Publishing, UK, 465-525.
- Taye, M., Jagema, T., Asefa Tadese, A., Mulatu, E., Lelisa, K., Damena, D., 2016. Study of ruminant fasciolosis in selected districts in upper Awash River basin, south western Shoa, Ethiopia. *J. Vet. Sci. Technol.*, 7(5), 368.
- Taylor, M.A., Coop, R.L., Wall, R.L., 2007. *Veterinary Parasitology*, 3rd Edition, Blackwell Publishing Ltd, 9600 Garsington Road, Oxford OX4 2DQ, UK, 244-255.
- Tengase, D., Kebede A., Taqaba, E., 2016. Comparison on sensitivity of coprological and post mortem examination in diagnosis of bovine fasciolosis: Prevalence of the disease in Bedele municipal abattoir. *Afr. J. Basic Appl. Sci.*, 8(1), 63-72.
- Thrusfield, M., 2005. *Veterinary Epidemiology*, 3rd Edition, Blackwell Science Ltd, 9600 Garsington Road, Oxford OX4 2DQ, UK, 232-245 and 327-328.
- Urquhart, G.M., Atmour, J., Duncan, J.L., Dunn, A.M., Jennigs, F.W., 1996. *Veterinary Parasitology*. 2nd ed., Scotland: Blackwell Science, 103-113.
- Yilma, J., Malone, J.B., 1998. A geographical information system forecast model for strategic control of fasciolosis in Ethiopia. *Vet. Parasitol.*, 78(2), 103-127.
- Yilma, J.M., Mesfin, A., 2000. Dry season bovine fasciolosis in northwestern part of Ethiopia. *Rev. Med. Vet.*, 151(6), 493-500.
- Yusuf, M., Ibrahim, N., Tafese, W., Deneke, Y., 2016. Prevalence of bovine fasciolosis in municipal abattoir of Haramaya, Ethiopia. *Food Sci. Qual. Manag.*, 48, 38-43.

How to cite this article: Oyda, S., Sheferaw, D., Aragaw, K., 2017. *Fasciola* infection prevalence and financial loss due to liver condemnation in cattle slaughtered at Wolaita Sodo municipal abattoir, southern Ethiopia. *Scientific Journal of Veterinary Advances*, 6(11), 203-209.

Submit your next manuscript to Sjournals Central and take full advantage of:

- Convenient online submission
- Thorough peer review
- No space constraints or color figure charges
- Immediate publication on acceptance
- Inclusion in DOAJ, and Google Scholar
- Research which is freely available for redistribution

Submit your manuscript at
www.sjournals.com

Sjournals
where the scientific revolution begins