



Research Article

Prevalence and Associated Economic Losses of Bovine Hydatidosis in Selected Abattoirs in Kericho, Kenya - An Analysis of Abattoir Data

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ABSTRACT

Hydatidosis is an emerging zoonotic parasitic disease that is caused by a dog tapeworm, *Echinococcus* species. The parasite has a complex life cycle with intermediate and definitive hosts. A retrospective study was carried out in six selected abattoirs in Kericho County to determine the prevalence and economic significance in beef industry. Post-mortem meat inspection records for the period 2010 and 2014 were reviewed for the number of animals slaughtered and the organs condemned due to hydatid cyst infection and associated economic importance. A total of 29,285 cattle were slaughtered during this period, with highest slaughter in the year 2012 of 20.8%, followed by 2013 and 2014 with 20.5% each, 19.5% in 2011 and 18.7% in 2010. Nine hundred and thirty one (931) livers and 817 lungs were condemned giving an overall prevalence of 3.2% and 2.8% respectively. The highest proportion of the livers condemned was in 2011 of 39.6% (369/931) with the least 8.6% (80/931) in 2010. Similarly, the highest number of lungs condemned was recorded in the year 2011 of 38.6% (315/817) and the least 9.1% (74/817) in 2010. Though more livers than lungs were condemned, there was no significant statistical difference between the two ($P=0.220$). The total revenue lost due to condemnation of these organs was KSh. 2,188,800 (~US\$22,335) with Kericho abattoir recording the highest economic loss (Ksh 448,000; ~US\$4,571). Hydatidosis causes huge economic losses and poses a risk to public health and therefore proper control measures are necessary to reduce infections in livestock and potential cross over to humans.

Key words: Cattle, Hydatidosis, Prevalence, Economic loss

INTRODUCTION

Hydatidosis is a zoonotic parasitic disease that is cosmopolitan and is caused by *Echinococcus* tapeworm larvae (Ansari-Lari, 2005). The lifecycle of this parasite is complex involving two hosts, the intermediate (herbivores) and definitive host (dog or wild carnivores) (Haftu and Kebede, 2014). The adult tapeworm resides in the small intestines of dogs with the intermediate stages having predilection in the liver, lung, spleen, kidney and the heart of herbivores (Haridy *et al.*, 2006). Herbivores are infected through ingestion of eggs of adult worms passed in feces of dogs, which hatch to oncospheres, penetrate the intestinal wall and taken through the bloodstream to their predilection sites where they develop as slow growing cysts (Wahlers *et al.*, 2012). The cysts exert pressure to these organs resulting in pathological changes (Pawloski *et al.*, 2001). Poorly equipped abattoirs around human settlement, home slaughter and feeding dogs with offal favors complete life cycle of this parasite

(Joseph, 2015). The clinical signs in livestock are in apparent and the reliable way of diagnosis is detection of cysts in the organs during post-mortem meat inspection. These parasites cause a direct economic loss to livestock keepers as they reduce milk production, reduce weight of carcass, rejection of infected organs and infertility losses due to infection (Sariozkan & Yalcin, 2009). In Kenya, Hydatidosis occurs in many parts but data is mostly available from nomadic pastoralists mainly Turkana and Maasai communities who keep huge herds of domestic ruminants (Wachira *et al.*, 1993; Wahlers *et al.*, 2012). Addy *et al.* (2012) estimated the prevalence of Hydatidosis at 10.8%, 16.5% and 25.8% in goats, sheep and cattle respectively stating liver as the most affected organ.

Man is an incidental host and provides a dead end to the life cycle of the parasite though exceptions have been reported in high endemic regions where humans act as intermediate host. For example, Turkana in Northern Kenya, people do not bury their dead where dogs and wild carnivores scavenge from their remains, and if the

cadavers have hydatid cysts, the parasite then completes the lifecycle (Macpherson, 1983). Two species, *E. granulosus* and *E. multilocularis* cause the two major forms of hydatid disease in human, Cystic Echinococcosis (CE) and Alveolar Echinococcosis (AE), respectively. Cystic Echinococcosis (CE) has a worldwide distribution and is encountered frequently in human (FAO, 1982), which is re-emerging as serious zoonoses of public health importance (Ansari-Lari, 2005; Torgerson and Budke, 2003). Diagnosis of Hydatidosis (imaging and laboratory tests), surgery, chemotherapy, hospitalization and fatalities are the economic losses associated with the disease in human (Budke *et al.*, 2006). Despite the attempts to control Echinococcosis in humans, it is still a threat to human health and livestock production in many countries including Kenya (Joseph, 2015).

Therefore, estimation of the distribution, prevalence and economic loss in cattle is important as it forms a basis on understanding of this parasite burden, health risk and the need for measures to control.

MATERIALS AND METHODS

The study was conducted in Kericho County in the former Rift Valley province. The population of the county is 752,396 persons (Kenya National Bureau of Statistics, 2009) with area coverage of 2,111km². The County's climate is classified as warm and temperate with average temperature of 18.1°C and approximately 1735mm of precipitation falls annually. The main economic activities include Tea and coffee plantation, livestock keeping, sugar cane farming, horticulture, floriculture, pineapples, pyrethrum and small scale trading.

Determination of prevalence of hydatid cysts infection and associated economic impact was done using annual field meat inspection reports sent to department of Veterinary County headquarters, Kericho County. This study was conducted between June and August 2015 during a 2-month project period sponsored by Field Epidemiology and Laboratory Training Program-Kenya (FELTP-Kenya) to final year veterinary students from University of Nairobi, Kenya. The data was retrospectively reviewed from six selected abattoirs from three sub-counties; Ainamoi, Belgut and Bureti. The sub-counties and abattoirs were randomly selected, two abattoirs from each sub-county. From Ainamoi sub-county Kericho and Ainamoi abattoirs were selected, from Belgut sub-county Kapsoit and Kapkugerwet were selected and from Bureti Sub-county Chemosot and Kipsitet were selected. The data included the annual total number of cattle slaughtered, number of livers and lungs condemned, the total weight condemned, and economic losses associated with condemnation of these organs. The 5kg estimated average weight of bovine liver with approximate KSh 400 per kilogram and 2kg average weight of lung at approximately KSh 200 market price (Joseph, 2015) were used to calculate the monetary value of condemned organs. The rate of 1 US \$= KSh 98 was used to convert into US dollars.

The cattle slaughtered in these abattoirs were brought by trekking or transport by road through livestock trade system from within the county and from neighboring Counties including Bomet, Nakuru, Nandi, Kisumu and Nyamira.

The information obtained from the records was coded in excel spreadsheet and analyzed using Stata® statistics (version 9.0; Stata Corporation, College Station, USA) for proportions, percentages and totals and presented with tables and graphs. The association between categorical variables was tested using Pearson Chi square test at P<0.05 significance level.

RESULTS

A total of 29,285 cattle were slaughtered in the six abattoirs in the 5-year study period. Table 1 shows the total number of cattle slaughtered in the selected abattoirs during the period 2010-2014. Out of these, 57.2% (16,749/29285) were males and 42.8% (12,536/29285) females. There was a significant statistical difference between infection in males and females (P<0.05). The highest slaughter was in the year 2012 of 20.8% (6091/29285), with the least of 18.7% in 2010. From this, 1013 cattle were infected with hydatid cyst in either the liver or the lung giving an overall prevalence of 3.5% (1013/29285).

From the data collected for the five years on the number of condemned livers whereby 931 livers were condemned, 54.5% (507/931) were for male cattle while 45.5% (424/931) from females. The highest number was recorded in the year 2011 of 39.6% (369/931), followed by 20.6% (192/931) in 2012, 16.0% (149/931) and 15.1% (141/931) were recorded in 2013 and 2014, respectively. However, 2010 recorded the least number condemned 8.6% (80/931) (Table 2; Figure 1).

From the data collected on condemned Bovine Lungs due to Hydatid infection for the period 2010-2014, 817 lungs were condemned 58.3% (476/813) were from male cattle while 41.7% (337/813) females. The highest number was recorded in the year 2011 of 38.6% (315/817). Twenty-three point seven (23.7%; 194/817) in 2012 followed by 2014 at 16.8% (137/817), then 11.9% (97/817) for 2013 and the least was recorded in 2010 at 9.1% (74/817) (Table 3; Figure 1).

Table 4 shows the number of slaughtered cattle in each of the six selected abattoirs in the period between 2010 and 2014, the number of livers and lungs found to be infected with Hydatid cysts during meat inspection and the calculated economic losses due to condemnation.

A total of 931 livers and 817 lungs were condemned during the 5-year period in the selected abattoirs. Kericho abattoir had the highest number of slaughtered animals (9644) and therefore the highest level of organ condemnation (189 livers and 175 lungs) due to hydatid infection. There was no significant statistical difference between the number of liver and lung infected in the 5-year period (P=0.220) though it appeared that more livers (3.2%) were infected compared to lungs (2.8%). In the selected abattoirs, more livers than lungs were condemned except in Kipsitet that had more lungs than livers being condemned. The total weight of the condemned organs was calculated and multiplied by the market price of the organ at that time to determine the economic loss.

The total money lost due to condemnation of these organs during period 2010-2014 was KSh. 2,188,800 (~US\$22,335). Kericho abattoir recorded the highest economic loss (Ksh 448,000; ~US\$4,571) due to Hydatidosis

Table 1: Total number of cattle slaughtered between 2010 and 2014 in 6 selected abattoirs in Kericho County based on meat inspection records.

Sub-county	Abattoir	2010	2011	2012	2013	2014
Ainamoi	Kericho	1840	1940	1965	1956	1943
	Ainamoi	742	807	811	905	897
Belgut	Kapsoit	649	711	780	795	810
	Kapkugerwet	405	482	577	614	621
Bureti	Chemosot	1024	934	872	836	816
	Kipsitet	807	849	1086	900	911
Total		5467	5723	6091	6006	5998

Table 2: Number of Bovine liver condemned due to Hydatidosis in the selected abattoirs in Kericho County in the period 2010-2014 based on meat inspection records.

Sub-county	Abattoir	2010	2011	2012	2013	2014
Ainamoi	Kericho	8	74	47	39	21
	Ainamoi	12	78	37	22	37
Belgut	Kapsoit	10	88	44	27	26
	Kapkugerwet	9	52	31	28	24
Bureti	Chemosot	34	62	21	23	18
	Kipsitet	7	15	12	10	15
Total		80	369	192	149	141

Table 3: Number of Bovine lungs condemned due to hydatidosis in the selected abattoirs in Kericho County in the period 2010-2014 based on meat inspection records.

Sub-county	Abattoir	2010	2011	2012	2013	2014
Ainamoi	Kericho	9	84	47	18	17
	Ainamoi	7	77	37	16	22
Belgut	Kapsoit	7	24	47	22	26
	Kapkugerwet	12	46	27	22	32
Bureti	Chemosot	32	65	24	12	25
	Kipsitet	7	19	12	7	15
Total		74	315	194	97	137

Table 4: The number of cattle slaughtered in selected abattoirs in Kericho County during the period 2010-2014, the number organs found to be infected with Hydatid cysts at meat inspection, the general prevalence and the calculated economic loss due to condemnation of infected livers and lungs.

Abattoir	No. slaughtered	No. infected		Total weight condemned (kg)		Economic loss (Ksh)	
		Liver	Lung	Liver	Lung	Liver	Lung
Kericho	9644	189	175	945	350	378,000	70,000
Ainamoi	4162	186	159	930	318	372,000	63,600
Kapsoit	3745	195	126	975	252	390,000	50,400
Kapkugerwet	2699	144	139	720	278	288,000	55,600
Chemosot	4482	158	158	790	316	316,000	63,200
Kipsitet	4553	59	60	295	120	118,000	24,000
Total	29,285	931	817			1,862,000	326,800
Prevalence		3.2%	2.8%			Total loss = KSh 2,188,800	

compared to other abattoirs. However, Kipsitet recorded the lowest economic loss in the 5-year period (KSh 142,000; ~US\$1,449).

The year 2011 recorded the highest prevalence of hydatid cysts in bovine liver and lung, though more livers (6.4%) were infected than lungs (5.5%). The second highest prevalence of liver infection was recorded in 2014 (3.4%), followed by 3.2% in 2012, 2.5% in 2013 and the least (1.5%) was reported in 2010. The second highest prevalence of lung infection was recorded in 2012 at 3.2%, followed by 2.3% in 2014, 1.6% in 2013 and the least (1.4%) in 2010 (Figure 2).

DISCUSSION

This study reveals that cattle in Kericho County are infected with *Echinococcus* parasites. For the period between 2010 and 2014, 3.5% (1013/29285) of slaughtered cattle were infected with hydatid cysts. This is

higher than what was reported in Egypt that the studied cattle were clear of hydatid infection (Dyab *et al.*, 2005). However, these findings were lower than what has been reported elsewhere; in Libya, 15% prevalence was reported (Kassem *et al.*, 2013) and 35.5% in Ethiopia (Fromsa and Jobre, 2011). This study showed that liver and lung are the commonly infected organs, which is in line with other studies (Sabri *et al.*, 2005). The general prevalence for the 5-year period, the data showed that more livers (3.2%) than lungs (2.8%) were infected. This is in agreement with the study carried out in Egypt that reported 39.3% livers infected compared to 32.2% of the lung (Mosaab *et al.*, 2013). However, contrary findings were reported in Faisalabad, Pakistan that more lungs (49.55%) than livers (29.32%) harbored hydatid cysts (Anwar *et al.*, 2000). The differences in the prevalence of Hydatidosis between this study and in other countries could be attributed to the differences in control strategies, type of farming systems, control of stray/semi-domesticated dogs and the national policy on parasite control.

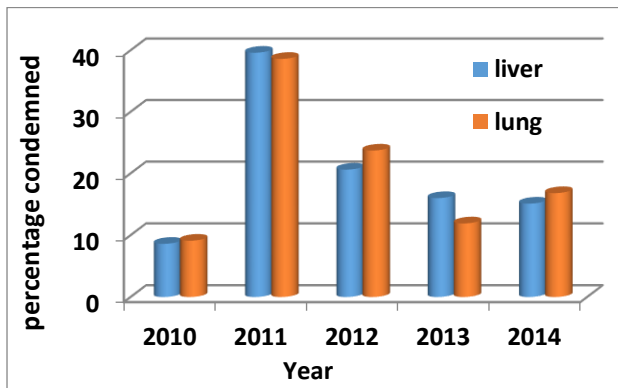


Fig. 1: The proportions of annual organs condemnation due to hydatid cyst infection in Kericho County in the period 2010-2014.

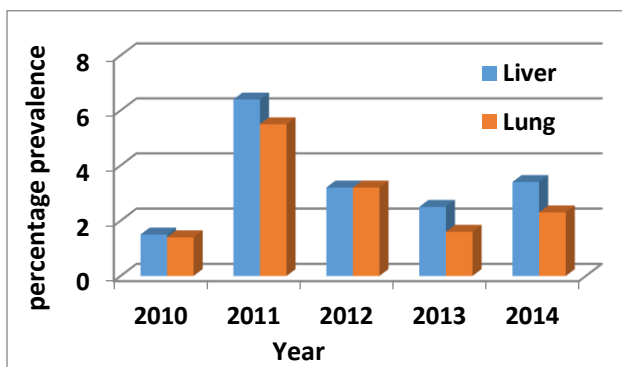


Fig. 2: Annual prevalence of Hydatidosis in cattle in selected abattoirs in Kericho County, for each year during the period 2010-2014, based on the abattoir meat inspection records.

The liver and the lung were the only two organs that were found to be infected in this study and this could be attributed to their nature of blood supply. They have a dense network of capillaries with small lumen size where hexachant embryos of *Echinococcus* parasite larvae lodge and develop into cysts (Estagil and Tuzer, 2007)

The data on characteristics of the identified cysts were not available to categorize them as either fertile or infertile. The information was only for the species and type of organ infected. The size of the cyst is important as small size cyst indicates infection of animals during heavy rains or immune-competency of the host that restrict the growth of the cysts (Miheret *et al.*, 2013).

In Kenya, a number of studies have been done on Hydatidosis in cattle but they were mostly from the pastoralist communities, the Maasai and Turkana. A study done three decades ago revealed a general prevalence of 8.9% bovine CE in Maasailand (Macpherson, 1985). In another study, a higher prevalence 19.4% was reported in slaughtered cattle in three divisions in Northern Turkana was reported (Njoroge *et al.*, 2001). The recent literature on survey of Hydatidosis in Kenya reported the highest (25.8%) prevalence among slaughtered cattle in the main abattoirs of Maasailand in Southern Kenya. These findings show that prevalence is on the rise despite the Government putting more resources toward improvement of diagnosis, treatment and control of CE in humans in Turkana, Northern Kenya. The current study reported lower prevalence of this parasite in Kericho County

compared to what has been reported in Arid and Semi-arid lands (ASAL) of Northern and Southern regions of the Country. The differences could be attributed to the differences in farming systems, climatic conditions, cultural practices, level of awareness on zoonotic importance of this parasite and infrastructural facilities.

In ASAL regions, the higher rate of CE infection could as well be attributed to uncontrolled animal trade, rustling (Njoroge *et al.*, 2001), home slaughter of cattle, insufficient slaughter facilities, open slaughter (Macpherson, 1985), feeding of offal to dogs, existence of free roaming dogs and not burying their dead (Battelli *et al.*, 2000).

There is scanty information on the prevalence and distribution of this parasite in other parts of the Country and this could be ascribed to the diagnosis of human CE cases in ASAL regions that might have prompted many researches in these regions compared to other parts of the Country.

The revenue lost due to hydatid infection was calculated based on the total weight lost and the associated monetary value. Any organ that is found to harbor hydatid cyst is rejected during meat inspection resulting in direct monetary loss. The global economic loss has been estimated at US\$ 2,190,132,464 annually due to livestock hydatid infection (Budke *et al.*, 2006). In a study done in Kisumu East and West districts, the total revenue between the period 2005 and 2009 lost from condemned bovine organs were KSh 1,674,000 (~US\$ 17,082) for liver and KSh 423,350 (~US\$ 4,320) for lung making a total of KSh 2,097,350 (~US\$ 21,402) (Joseph, 2015) which was lower than the finding of this study (~US\$22,335). The differences could be attributed to differences in localities, scope of study, time of studies and the monetary value of bovine organs. The present study was conducted in selected abattoir from three sub-counties (districts) compared to two in the former study. However, in a 6-month period of study in municipality abattoir, Ethiopia, \$ 23,876 financial loss was reported which is higher than the finding of this study. The differences in estimated monetary loss between countries may be due to differences in number slaughter, methodology employed for identification, livestock population and production systems and monetary value of bovine organs (Abebe & Yilma, 2012).

Conclusion

Hydatidosis in cattle is present in Kericho County as in other parts of the country and it mostly affects the liver and the lung. Rejection of infected organs during post-mortem meat inspection results in high economic losses. Since this is a parasitic disease of public health importance, proper control measures should be put in place to control the parasite in intermediate and definitive hosts as well as improving diagnostic and treatment facilities for human cases to reduce fatalities.

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