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A Slaughterhouse Survey of Liver Lesions in Slaughtered Cattle, Sheep and Goats at Arusha, Tanzania

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Abstract: This study, reviews a 3 year period (2005 to 2007) record of slaughtered cattle, sheep and goats at Arusha abattoir in Northern Tanzania. It aimed to determine the prevalence of disease conditions affecting the liver. A total of 115186 cattle, 61551 sheep and 37850 goats were slaughtered and 18829 (16.3%), 10515 (17.1%) and 7011 (18.5%) livers of cattle, sheep and goats respectively were condemned due to 11 diseases/conditions namely fasciolosis, stilesiosis, hydatidosis, calcified cysts, abscess, *Cysticercus tenuicollis* infection, telangiectasis, hepatitis, fatty degeneration, melanosis and liver cirrhosis. Of the slaughtered cattle, in sheep and goats a significantly ($p<0.05$) higher prevalence of fasciolosis was recorded in cattle liver (8.6%) than sheep (3.1%) and goats (3.1%). Collectively, fasciolosis was the leading cause of liver condemnation and was responsible for 52.6, 18.2 and 16.9% of total liver condemnations in cattle, sheep and goats respectively. Highest percent of liver condemnations were observed during the rain season (March to June). Because of their zoonotic nature, the observed high frequency of hydatidosis, fasciolosis and *C. tenuicollis* infections is thought to pose a public health risk among consumers. The public health implications of the quantity of infected livers condemned on consumers and the role which post-mortem inspection plays in safeguarding the health of the public is enormous. Although the data obtained from this survey could not be wholly relied upon as accurate, it can be used as a baseline for the proper evaluation of the status of these liver diseases in future co-ordinated researches.

Key words: Liver diseases, slaughterhouse, condemnation, cattle, sheep, goats

INTRODUCTION

Tanzania has a cattle population of 17.7 million of which 95% are of the indigenous Tanzanian Shorthorn Zebu (TSZ) genotype kept by the traditional sector (MAFS, 2002). Goats and sheep population is estimated at 12.5 million and 3.5 million respectively and are also kept by pastoral communities as source of food and income generation thereby improving socio-economic status (MAFS, 2002). The contribution of livestock to the national economy and food security is 18% of total GDP. The indigenous cattle provide more than 70% of the meat as well as 67% of milk consumed in Tanzania.

Livestock brought for slaughter in Arusha and other urban areas in Tanzania come from pastoral and agro-pastoral community villages where disease control regimens are limited to

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endemic tick borne diseases and trypanosomosis (Swai *et al*., 2005). Veterinary services are rarely extended to villages for many reasons including shortage of veterinary staff, poor transport infrastructure and limited diagnostic facilities and drugs (Kambarage *et al*., 1995). The lack of veterinary services to these livestock rearing areas suggests a possible widespread occurrence of diseases in traditional cattle herds. This further suggests that most cattle brought for slaughter may harbour chronic or subclinical infections which can rarely be detected during ante-mortem examination (Kambarage *et al*., 1995).

Food animals are useful as they supply quality protein and revenue to man, but on the other hand they serve as vehicles of disease transmission. Beside economic losses, diseases of cattle, sheep and goats might constitute an epidemiologic and zoonotic threat. As such problems concerning meat hygiene and possible health risks to the consumer should be documented during both ante mortem and postmortem examination. In this context, meat-inspection data are a potential source of information and have an important role to play in epidemiology and preventive veterinary medicine (Gracey *et al*., 1999). Monitoring disease and other conditions at slaughter has been recognized as one way of assessing the disease status of a herd (Herenda and Jackel, 1994), however this source of information is not being fully exploited worldwide. The purpose of the present study was to investigate the occurrences and prevalence of disease conditions affecting the liver of slaughter ruminants at Arusha abattour, Tanzania during a 3-year period (2005 to 2007).

MATERIALS AND METHODS

Study Area and Animals

The study was a retrospective abattoir survey which used abattoir data for a period of 3 years from January 2005 to December 2007 and involved 11586 cattle, 61551 sheep and 37850 goats slaughtered at the municipal abattoir in Arusha region, Tanzania. The municipality lies between 1.6° and 4.0° latitude South and 34.5° and 37.5° longitude East. According to Tengeru meteorological station in Arusha, Tanzania the region has both unimodal and bimodal rainfall patterns, with short rains starting in September and ending in December and long rains starting in March and ending in May. During data analysis, a rainy season' was assigned to September-December and March-May periods and the rest of the months were regarded as a dry season. The rainfall in highlands is bimodal and receive between 800 to 1,200 mm of rainfall and lowlands are unimodal receiving 500 to 700 mm of rainfall. The mean monthly temperature range of Arusha region is 20°C. However during the cooler period (June-August) the mean average temperature drops to 17°C.

It was not possible to get the exact records on breed, gender and age for each slaughtered animals during the study period due to poor recording systems at the abattoir. With regards to the set up of livestock sector in Tanzania particularly in Arusha region, almost all animals sent for slaughter are adult and come from traditional sector. It is documented that more than 98% of the livestock population in the country are of indigenous types, kept in the traditional sector. For example, the indigenous cattle are dominated by the Tanzania Short horn Zebu (TSZ) and Ankole breeds (MAFS, 2002). It was also difficult to precisely trace back the geographical origins of all animals slaughtered due to lack of reliable animal identification method making it difficult to relate the findings to a particular locality.

Criteria for Selection of Cases and Procedures

Daily condemnation records for cattle, sheep and goats in the Arusha municipal abattoir were used to establish the prevalence of liver diseases and lesions involved. Records of total

number of animals slaughtered and the liver lesion(s) observed and condemned were collected. Routinely, meat inspectors physically examined all live animals presented for slaughter a day before or shortly prior to slaughter and only clinically healthy animals were registered for slaughter. All animals found clinically unhealthy during antemortem examination were isolated in the detention place for further observations. During the routine postmortem meat inspection, a thorough visual examination, palpation and systematic incision of carcasses and visceral organs particularly, lungs, liver, kidney, heart and spleen was carried out according to procedures described by Gracey *et al.* (1999) and the Tanzania general guidelines on meat inspection. Liver diseases and lesions were grossly diagnosed based on pathological changes of organ colour, size, morphology, consistence, presence of lesions and parasites. At the end of meat inspection every day, all partial and total condemned organs were taken to the abattoir laboratory for further examination and identification of the lesions and parasites. In case of doubts, lesions that would further need investigations and as means of external validation, the abattoir submits samples to Arusha Veterinary Investigation Centre (VIC) to confirm diagnosis of conditions detected during meat inspection.

Quality Control of the Data

As a means of quality control of data, recorded cases excluded from this study were those with no proper diagnosis of liver lesions and ambiguous information on species and slaughter date. Primary data for liver fasciolosis were also collected by performing inspection of cattle slaughtered at the abattoir for 30 days in July 2008 to validate secondary data from the retrospective study. Liver inspection was carried out by visual examination, palpation and incision. *Fasciola* infection was judged based on liver enlargement with bumpy, raised and/or depressed areas, dark blue to black disclourations, hardness in consistence and on incision liver flukes sometimes were seen.

For *Fasciola* species identification, one or more samples of the worms were collected from 125 livers which had active infection. The worm samples were preserved in universal bottles which contained 70% ethanol during field work. The samples were subsequently transported to the laboratory at the Faculty of Veterinary Medicine, Sokoine University of Agriculture in Morogoro.

Laboratory Sample Processing and *Fasciola* Species Identification

For each of the 125 samples of *Fasciola* collected, a preliminary identification was done through observation of the morphology and measurements as described by Soulsby (1982). Thereafter, 60 randomly drawn samples, with an average of 15 per each source of the cattle were stained for detailed microscopic examination. Staining of *Fasciola* was carried out as described by Soulsby (1982). Briefly, *Fasciola* worms were hydrated using the sequence of 70, 50, 30% ethanol (changed two times) for 5-10 min in each. Then the worms were stained in 1 mL aceto alum carmine solution diluted with 5 mL of distilled water for 10 min. Thereafter, the worms were washed in water before differentiation of specimens in 2% aqueous hydrochloric acid solution until their surface became pale pink and the outline of the internal organs were visible. The worms were washed in distilled water before being dehydrated in 30, 50, 70, 90% and absolute alcohol two times in each concentration for 5-10 min. Lastly, the worm samples were cleared in clove oil, mounted on the glass slide and observed under stereo microscope at 20 x magnification with a side lamp.

For further *Fasciola* species identification, eggs which were laid in the 70% ethanol were recovered by sedimentation technique. A total of 50 samples had eggs which were examined using a compound microscope with a 10x and 40x objective lens.

Data Analysis

Data were analysed using Epi Info version 6 statistical software (Coulombier *et al*., 2001). Using statcalc, proportions of categorical variables were computed and further compared using chi-square test at critical probability of $p<0.05$. The strength of associations between dependent and independent variables were determined using 2×2 contingency tables. The variables compared included proportions of liver lesions by years, seasons and species.

RESULTS

A total of 115186 cattle, 61551 sheep and 37850 goats were slaughtered between 2005 and 2007 (Table 1) and during the period 18829 (16.3%), 10515 (17.1%) and 7011 (18.5%) cattle, sheep and goat livers respectively were condemned. Overall, fasciolosis was the leading cause of liver condemnation and was responsible for 52.6, 18.2 and 16.9% of total liver condemnations in cattle, sheep and goats respectively (Table 2). A significantly ($p<0.05$) higher prevalence of fasciolosis was also recorded in cattle liver (8.6%) than sheep (3.1%) and goats (3.1%). In the primary data obtained in July 2008, out of 4329 livers inspected and 469 (10.8%) were condemned due to various causes. Out of the condemned livers, 150 (31.9%) were due to fasciolosis (Table 3). The prevalence of fasciolosis recorded during July 2008 was 3.4% and up to 83.3% of the livers condemned due to fasciolosis had active infection with live flukes. Laboratory species identification of liver flukes sampled revealed that all the 60 worm samples examined were *Fasciola gigantica*.

Table 1: The number of animals slaughtered and liver condemnations due to different disease conditions recorded between 2005 and 2007

			No. (%) of animals diagnosed to have different disease conditions and lesions in the liver					
Year	Sp.	No. of animals slaughtered	Fasciolosis	Stilesiosis	Hydatidosis	Calcified cysts	Abscesses	*Cysticercus tenuicollis* infection
2005	Cattle	31080	3315 (10.7)	0 (0.0)	773 (2.5)	702 (2.3)	462 (1.5)	0 (0.0)
	Sheep	14501	435 (3.0)	1603 (11.1)	543 (3.7)	244 (1.7)	156 (1.1)	63 (0.4)
	Goats	9088	255 (2.8)	953 (10.5)	398 (4.4)	222 (2.5)	184 (2.0)	35 (0.4)
2006	Cattle	40069	3579 (8.9)	0 (0.0)	1721 (4.3)	819 (2.1)	491 (1.2)	0 (0.0)
	Sheep	20266	693 (3.4)	1708 (8.4)	720 (3.6)	213(1.1)	307 (1.5)	35 (0.2)
	Goats	14020	510 (3.6)	906 (6.5)	541 (3.9)	304 (2.2)	262 (1.9)	44 (0.3)
2007	Cattle	44037	3009 (6.8)	0 (0.0)	1211 (2.7)	637 (1.5)	366 (0.8)	0 (0.0)
	Sheep	26784	784 (2.9)	1691 (6.3)	883 (3.3)	201 (0.8)	139 (0.5)	51 (0.2)
	Goats	14742	420 (2.8)	922 (6.3)	599 (4.1)	695 (4.8)	135 (0.9)	39 (0.3)
Total	Cattle	115186	9903 (8.6)	0 (0.0)	3705 (3.2)	2158 (1.9)	1319 (1.1)	0 (0.0)
	Sheep	61551	1912 (3.1)	5002 (8.1)	2146 (3.5)	658 (1.1)	602 (1.0)	147 (0.2)
	Goats	37850	1185 (3.1)	2781 (7.3)	1538 (4.1)	695 (1.8)	581 (1.5)	103 (0.3)

Table 2: No. (%) of condemned livers due to liver diseases among the condemned livers between 2005 to 2007 in slaughter stock at Arusha abattoir, Tanzania

	No. (%) of livers condemned		
Disease conditions	Cattle (n = 18829)	Sheep (n = 10515)	Goats (n = 7011)
Fasciolosis	9903 (52.6)	1912 (18.2)	1185 (16.9)
Stilesiosis	0 (0.0)	5002 (47.6)	2781 (39.7)
Hydatidosis	3705 (19.7)	2146 (20.4)	1538 (21.9)
Calcified cysts	2158 (11.5)	658 (6.3)	695 (9.9)
Abscesses	1319 (7.0)	602 (5.7)	581 (8.3)
Cysticercus tenuicollis infection	0 (0.0)	149 (1.4)	103 (1.5)
Others (telangiectasis, hepatitis, fatty degeneration, melanosis and liver cirrhosis)	1744 (9.2)	46 (0.4)	128 ((1.8)

Table 3: Prevalence of bovine liver fasciolosis based on cattle market as recorded in July 2008

Cattle market	No. of cattle slaughtered	No. of liver condemned (%)	No. (%) of liver condemned due to *Fasciola* infection (proportion of livers condemned)	Fasciolosis prevalence (%)
Meserani	1707	193 (11.3)	61 (31.6)	3.5
Ngaramtoni	1232	153 (12.4)	36 (23.5)	2.9
Themi	752	83 (6.0)	39 (46.9)	5.1
Oldonyosambu	640	16465 (13.3)	14 (35.0)	2.1
Total	4329	469 (10.8)	150 (31.9)	3.4

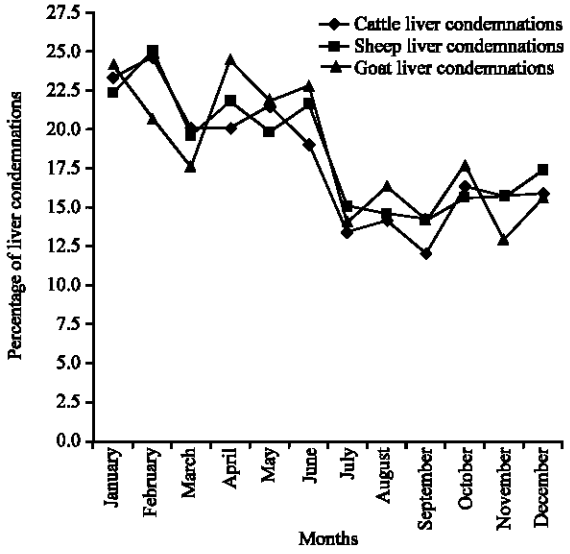

Fig. 1: Monthly fluctuation of liver condemnations between 2005 to 2007

The annual prevalence of hydatidosis, calcified cysts and abscesses in different animal species during the survey period was almost constant (Table 1). Other disease conditions which were recorded at a low prevalence included telangiectasis, hepatitis, fatty degeneration, melanosis and liver cirrhosis. Stilesiosis and *C. tenuicollis* infection were recorded only in sheep and goats. The percentages of different liver conditions recorded in 2005, 2006 and 2007 were not statistically different ($p>0.05$) among cattle, sheep and goats (Table 1). Similarly, the percentages of different liver lesions recorded in cattle, sheep and goats were statistically not different ($p>0.05$) (Table 1). There were no significant ($p>0.05$) variations between liver condemnation percentages due to various diseases during rain and dry seasons among cattle, sheep and goats. Figure 1 shows the monthly fluctuation of liver condemnations between 2005 to 2007. Highest percent of liver condemnations were observed during the rain season (March to June).

DISCUSSION

The findings of this study show the prevalence of liver diseases in cattle, sheep and goats slaughtered at Arusha municipal abattoir. Cattle had the highest number of liver condemnation rate and fasciolosis was the leading cause of condemnation of the liver, in cattle, sheep and goats alike. The fact that only clinically healthy animals are slaughtered the

true prevalence of different liver diseases could probably be much higher as many cases were likely to remain unnoticed or undiagnosed because of meat inspectors' personal error, non-cooperativeness of the butchers, use of gross pathology in the diagnosis of the diseases and general poor record keeping. Furthermore, given the large size of the liver and inadequate meat inspectors, it is also possible that prevalence of some diseases has been underestimated. Furthermore, some livers with localized or partial infection might have been passed as fit for human consumption after trimming off the affected parts of which such cases might have not been recorded. This merits for more extensive epidemiological investigations to better determine the prevalence, economic impact and the public health importance of the diseases. Although, abattoir surveys have limitations, they are an economical way of gathering information on livestock diseases. Nevertheless, the observed frequency of hydatid cysts and *C. tenuicollis* and liver fasciolosis at slaughter house should be considered as a risk for public health since they are zoonotic.

Liver condemnation due to fasciolosis in cattle (8.6%), sheep (3.1%) and goats (3.1%) suggest the parasite economic importance in domestic ruminants. Indeed, fasciolosis was the leading cause of liver condemnations as had also been previously reported by Kambarage *et al*. (1995). Similar findings have been reported in Kenya (Mungube *et al*., 2006). Nevertheless, a survey in Hai Tanzania, Mekelle in Ethiopia and Kafue in Zambia reported a higher prevalence of 14.04, 24.3 and 41.3%, respectively (Phiri *et al*., 2005; Swai and Ulicky, 2009; Berhe *et al*., 2009). Apart from its veterinary and economic importance throughout the world, fasciolosis has recently been shown to be a re-emerging and widespread zoonosis affecting a number of human populations (Mas-Coma *et al*., 2005; Esteban *et al*., 2003). Furthermore, as a zoonotic disease, the World Health Organization (WHO) estimated that 2.4 million people were infected with *Fasciola* in 1995 and a further 180 million were at risk of infection (World Health Organization, 1995).

Similarly, *Stilesia* infection contributed significantly to sheep and goat liver condemnations. Elsewhere in Eastern Africa, a survey in Ethiopia by Sissay *et al.* (2008) reported a stilesiosis prevalence of 40 and 46% in sheep and goats respectively. A study by Mungube *et al*. (2006) in Kenya reported a prevalence of 28 and 22% in sheep and goats, respectively. Although, *Stilesia* infection is not usually perceived to be important in live animals, the parasite contributes significantly to condemnations of otherwise edible meat in sheep and goats as it has been shown in the current study.

Up to 3.2, 3.5 and 4.1% of cattle, sheep and goat slaughtered at Arusha abattoir between 2005 and 2007 had Hydatid Cysts (HC) in the liver. Similar low level of infection rates of HC were reported by Njoroge *et al*. (2002) and Ansari-Lari (2005). In contrast, a high prevalence of HC in cattle, sheep and goat liver was reported in Sudan (Elmahdi *et al*., 2004), Morroco (Azlaf and Dakkak, 2006) and Ethiopia (Kebede *et al*., 2009). The differences in prevalence of HC may arise due to differences in environmental conditions that are conducive to the perpetuation of the parasite, abundance of infected definitive host, livestock husbandry, stocking rate, nature of the pasture and grazing patterns of animals. Importantly, HC is a potential threat to humans in Tanzania. Because of presence of large stray dog population in the country and improper disposal of abattoir condemned organs, there is a big possibility of the disease to affect a higher human population. A study by Ernest *et al*. (2009) reported higher incidences of HC in the Maasai population of northern Tanzania. It is clear therefore that the abattoir HC records in domestic ruminants in the region gives more evidence of possible higher rates of the disease in humans.

Published reports on the incidence of *C. tenuicollis* shows a wide range varying from 0.2% in Australia to 23% in Nigeria (Akinboade and Ajiboye, 1983; Sanyal and Sinha, 1983). A study in Gambia reported a prevalence of 2% in the goats and 2-5% in the sheep (Goossens *et al*., 1998), Johnson *et al*. (1999) reported 1.9% infection rate in goats in the Sultanate of Oman while Kara *et al*. (2009) reported a prevalence of 12.13% in Turkey. *C. tenuicollis* is the intermediate stage of the tapeworm *Taenia hydatigena*, which is found in a number of carnivore species. It is likely in Tanzania that, the incriminating definitive host is the stray dogs and possibly the fox. In this study, the prevalence of 0.2 and 0.3% for *C. tennuicolis* in sheep and goats respectively has been observed. The prevalence of cysticercosis was probably much higher, as *C. tenuicollis* most often resides in extrahepatic sites, such as the mesentery, omentum and serosal surfaces of the peritoneal cavity and may be encountered with aberrant migrations in the lungs and abdominal viscera (Johnson *et al*., 1999). Although, *C. tenuicollis* is not generally considered a parasite of man, its public health significance should not be under rated, as cases have been reported in this species and in the absence of suitable hosts the parasite may adapt itself to humans (Akinboade and Ajiboye, 1983).

Compared to the findings of Cadmus and Adesokan (2009), who reported 2.9% condemnation rate of liver due to hepatic abscesses in Western Nigeria, in the present study the liver condemnation rate due to abscesses was 1.1% in cattle, 1.0% in sheep and 1.5% in goats. Rosa *et al*. (1989) reported the incidence of hepatic abscesses in goats in Northeast Brazil to be 2.5%. However, Ahmedullah *et al*. (2007) reported 3.8% liver condemnation rate in Bangladesh caused by abscesses. Normally liver abscesses are bacterial based and the infection occurs due to migrating intestinal parasites which pre-optimize the conditions for a secondary bacterial infection (Rosa *et al*., 1989). Moreover, hepatitis in slaughter stock was recorded at 1.0% of the slaughtered cattle. This was commonly associated, with liver enlargement manifested by gross rounding of the edges (hepatomegaly) and sometimes adhesions to the peritoneal membrane.

Calcified cysts were also among the lesions which significantly contributed to the liver condemnation in cattle (1.9%), sheep (1.1%) and goats (1.8%). Higher from the current finding, Swai and Ulicky (2009) reported a prevalence of 7.3% of calcified cysts in Hai Tanzania. The actual causes of the cysts was not established but a number of parasitic conditions can be listed like hydatidosis, *C. tenuicollis*, *C. bovis*, *Linguatula larvae* and toxocariasis.

Other conditions observed at a lower percentage during this study included, telangiectasis, fatty degeneration, melanosis and liver cirrhosis. The rarity of these lesions would suggest that they are likely to be of minor concern and would be expected to appear only sporadically.

In general, liver condemnations as have been reported in this study impact negatively on the economic status of the traders and the livestock industry at large. For example, Mwabonimana (2008) estimated the economic loss at Arusha abattoir Tanzania per annum due to fasciolosis liver condemnation to be Tanzania shillings (TZS 21 600 000/- (equivalent to US $18 000). This constituted a substantial loss to the economy of the slaughter stock owners under study as such an amount of money would have been harnessed into livelihood improvements. Though infected livers were condemned and rendered unfit for human consumption, there exist some public health threats from animals slaughtered at the abattoir due to the possibility of some missed cases as a

result of poor cooperation between butchers and meat inspectors and other malpractices including hiding of infected meat from meat inspectors to avoid economic losses on their side.

Indeed, the condemnation of cattle, sheep and goats livers at slaughterhouse in Arusha represents a significant economic loss. Some of the conditions described however can be prevented. Cases of hydatidosis could be reduced by better control of stray dogs. Since most liver conditions were caused by parasites, deworming programmes coupled with good animal husbandry would likely be effective in lowering their incidence.

Some of the limitations, however; encountered in this study included the use of only gross pathology in the diagnosis of the diseases, thus only those diseases with gross pathological lesions that are pathognomonic were likely to be diagnosed. The records may also have been under-estimated because of general poor record keeping due to shortage of staff and laziness on the part of the officers. In spite of the limitations mentioned, the public health implications of the quantity of infected livers condemned at Ausha municipal abattoir on the consumers and the role which post-mortem inspection plays in safeguarding the health of the public cannot be overemphasized. Therefore, there is a need for adequate meat inspection in Tanzanian abattoirs in order to reduce wastages, identify diseases and thereby minimize associated public health risks.

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REFERENCES

Ahmedullah, F., M. Akbor, M.G. Haider, M.M. Hossain and M.A.H.N.A. Khan *et al*., 2007. Pathological investigation of liver of the slaughtered buffaloes in barisal district. Bangladesh J. Vet. Med., 5: 81-85.

Akinboade, O.A. and A. Ajiboye, 1983. Studies on cysticercosis of small ruminants in Nigeria. Int. J. Zoonosis, 10: 164-166.

Ansari-Lari, M., 2005. A retrospective survey of hydatidosis in livestock in Shiraz, Iran, based on abattoir data during 1999-2004. Vet. Parasitol., 133: 119-123.

Azlaf, R. and A. Dakkak, 2006. Epidemiological study of the cystic echinococcosis in Morocco. Vet. Parasitol., 137: 83-93.

Berhe, G., K. Berhane and G. Tadesse, 2009. Prevalence and economic significance of fasciolosis in cattle in Mekelle Area of Ethiopia. Trop. Anim. Health Prod., 4: 1503-1504.

Cadmus, S.I.B. and H.K. Adesokan, 2009. Causes and implications of bovine organs/offal condemnations in some abattoirs in Western Nigeria. Trop. Anim. Health Prod., 4: 1455-1463.

Coulombier, D., R. Fagan, L. Hathcock and C. Smith, 2001. Epi Info 6 Version 6.04. A Word Processing, Database and Statistical Program for Public Health. Centers for Disease Control and Prevention, Atlanta, Delaware, USA.

Elmahdi, I.E., Q.M. Ali, M.M. Magzoub, A.M. Ibrahim, M.B. Saad and T. Romig, 2004. Cystic echinoccosis of livestock and humans in central Sudan. Ann. Trop. Med. Parasitol., 98: 473-479.

Ernest, E., H.E. Nonga, N. Kynsieri and S. Cleaveland, 2009. A retrospective survey of human hydatidosis based on hospital records during a period from 1990–2003 in Ngorongoro, Tanzania. Zoonosis Public Health,

Esteban, J.G., C.F. Gonzalez, C. Curtale, C. Muñoz-Antoli and M.A. Valero *et al*., 2003. Hyperendemic fascioliasis associated with schistosomaisis in villages in the Nile delta of Egypt. Am. J. Trop. Med. Hyg., 69: 429-437.

Goossens, B., S. Osaer, S. Kora, K.J. Chandler and L. Petrie *et al*., 1998. Abattoir survey of sheep and goats in The Gambia. Vet. Rec., 142: 277-281.

Gracey, J.F., D.S. Collins and R.J. Huey, 1999. Poultry production, slaughter and inspection. In: Meat Hygiene, Gracey, J., D.S. Collins and R. Huey (Eds.). 10th Edn., W.B. Saunders Co. Ltd., New York, ISBN: 0702022586, pp: 261–287.

Herenda, D. and O. Jackel, 1994. Poultry abattoir survey of carcass condemnation for standard, vegetarian and free range chickens. Can. Vet. J., 35: 293-296.

Johnson, E.H., D. Muirhead, G.J. King, J. Ochei and R. Al-Busaidy, 1999. An abattoir survey of Caprine liver diseases in the Sultanate of Oman. Vet. J., 158: 216-220.

Kambarage, D.M., S.I. Kimera, R.R. Kazwala and B.M. Mafwere, 1995. Disease conditions responsible for condemnation of carcasses and organs in short-horn Zebu cattle slaughtered in Tanzania. Prev. Vet. Med., 22: 249-255.

Kara, M., Y. Gicik, B. Sari, H. Bulut and M.O. Arslan, 2009. A slaughterhouse study on prevalence of some helminths of cattle and sheep in Malatya province, Turkey. J. Anim. Vet. Adv., 8: 2200-2205.

Kebede, N., A. Mitiku and G. Tilahun, 2009. Hydatidosis of slaughtered animals in Bahir Dar Abattoir, Northwestern Ethiopia. Trop. Anim. Health Prod., 41: 43-50.

MAFS, 2002. Basic Data-Agriculture Sector 1994/95–2000/2001. Ministry of Agriculture and Food Security, Tanzania, pp: 72.

Mas-Coma, S., M.D. Bargues and M.A. Valero, 2005. Fascioliasis and other plant-borne trematode zoonoses. Int. J. Parasitol., 35: 1255-1278.

Mungube, E.O., S.M. Bauni, B.A. Tenhagen, L.W. Wamae, J.M. Nginyi and J.M. Mugambi, 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.

Mwabonimana, M.F., 2008. Cattle liver condemnation at Arusha meat company Ltd, Tanzania: causes and its financial implication. A Research Paper Submitted in Partial Fulfilment of the Requirements for the Degree of Master of Preventive Veterinary Medicine of Sokoine University of Agriculture, Morogoro, Tanzania.

Njoroge, E.M., P.M. Mbithi, J.M. Gathuma, T.M. Wachira, P.B. Gathura, J.K. Magambo and E. Zeyhle, 2002. A study of cystic echinococcosis in slaughter animals in three selected areas of Northern Turkana, Kenya. Vet. Parasitol., 104: 85-91.

Phiri, A.M., I.K. Phiri, S. Siziya, C.S. Sikasunge, M. Chembensofu and J. Monrad, 2005. Seasonal pattern of bovine fasciolosis in the Kafue and Zambezi catchment areas of Zambia. Vet. Parasitol., 134: 87-92.

Rosa, J.S., E.H. Johnson, F.S. Alves and L.F. Santos, 1989. A retrospective study of hepatic abscesses in goats: Pathological and microbiological findings. Br. Vet. J., 145: 73-76.

Sanyal, P.K. and P.K. Sinha, 1983. Caprine metacestodiasis: Incidence in West Bengal. Haryana Vet., 22: 38-40.

Sissay, M.M., A. Uggla and P.J. Waller, 2008. Prevalence and seasonal incidence of larval and adult cestode infections of sheep and goats in eastern Ethiopia. Trop. Anim. Health Prod., 40: 387-394.

Soulsby, E.L.J., 1982. Helminths, Arthropods and Protozoans of Domesticated Animals. 7th Edn., Bailliere Tindall, London, pp: 809.

Swai, E.S., A.N. Mbise, V. Kessy, E. Kaaya, P. Sanka and P.M. Loomu, 2005. Farm constraints, cattle disease perception and tick management practices in pastoral Maasai community-Ngorongoro, Tanzania. Livest. Res. Rural Develop., Vol. 17, http://www.lrrd.org/lrrd17/2/swai17017.htm.

Swai, E.S. and E. Ulicky, 2009. An evaluation of the economic losses resulting from condemnation of cattle livers and loss of carcass weight due to fasciolosis: A case study from Hai town abattoir, Kilimanjaro region, Tanzania. Tanzania. Livestock Res. Rural Dev., Volume 21

World Health Organization, 1995. Control of foodborne trematode infections. WHO Tech. Report Series, 849: 1-157.