Africa Journal of Animal and Biomedical Sciences 5 (1), 2010
ISSN: 1819-4214

Prevalence of endoparasites in cattle with zoonotic potential within urban and peri-urban areas of Lake Victoria Basin, Kenya

P.W.N. Kanyari*[1] J. M. Kagira[2], R.J. Mhoma[3]
[1]Department of Veterinary Pathology, Microbiology and Parasitology, Faculty of Veterinary Medicine, University of Nairobi, P.O. Box 29053, Nairobi, Kenya
[2] Kenya Agricultural Research Institute, P.O.Box 363, Kikuyu,Kenya
[3]Open University of Tanzania, P.O. Box 23409, Dar-es-Salaam, Tanzania.
* Corresponding author: kanyari@uonbi.ac.ug

Abstract

The growing human population and the tendency to keep livestock in urban centers has caused concern due to the unplanned nature of such developments and the constraints they cause. A study was carried in six sites within Kisumu urban and peri-urban focused on the cattle parasites. Three different age groups were faecal sampled for determination of the prevalence and infection levels of various helminth and protozoans especially those with zoonotic potential. Associations and correlations between different variables were determined. The prevalence of various parasite types was 51% strongyles, 2% *Strongyloides papillosus*, 2% *Toxocara vitulorum*, 2% *Trichuris* species. Others were *Fasciola* 64.2%; *Paramphistomum* 31.3%, Moniezia species (16%) and *Entomoeba* 83%; Coccidia species 30%; *Giardia* species 14% and *Balantidium coli* 6.6%. The correlations in prevalence and intensity between age, breed, different parasite types and area of origin are discussed. Strongyles were the most common nematodes and especially among the under one year olds. Trematodes were significantly more frequent and intense in young stock and adults compared to the calves. Majority cattle had 2 to 3 parasite types while very few had none, single or multiple infections involving 4 parasite types. The zoonotic potential for these parasites is discussed in relation to the possible human infections.

Key words: Cattle, endo-parasites, zoonosis, urban, peri-urban, Lake Victoria Basin

Introduction

Urban and peri-urban livestock keeping is a socio-economic and livelihood enhancing strategy in urban centers around the Lake Victoria [1,2]. In Kisumu municipality, livestock keeping is common in the open spaces which include road sides, dump sites with solid waste and unconstructed lands [2]. The farmers in the municipality are faced with many production constraints, chief amongst them being livestock diseases. A preliminary questionnaire survey showed that diarrhea and helminthosis were perceived by urban and peri-urban farmers in Kisumu to be highly prevalent in the cattle [3]. The two conditions could be related since the gastrointestinal nematodes are known to cause gastroenteritis leading to diarrhoea. In the municipality, flooding from local rivers, which occurs during the two rainy seasons, often leads to creation of wetlands such as swamps and these can support life cycle stages and vectors of different livestock parasites.

Parasitic diseases constitute a major impediment to livestock production in sub-Saharan Africa owing to the direct and indirect losses they cause [4]. For example, it has been estimated that in Kenya, returns could be increased by as much as 470% by controlling haemonchosis [5], while fasciolosis in Kenya leads to losses estimated at ₤7 million annually, through a combination of poor productivity, death of stock, condemnation of infected livers and reduction in carcass quality [6,7]. However, these are conservative estimates since there are only a few studies on the epidemiology and economic importance of these trematode parasites in Kenya and other sub-Saharan African countries. The occurrence of risk factors for zoonoses due to livestock keeping in the African towns has been highlighted in recent studies [8,9]. In Kisumu, a recent questionnaire survey showed the presence of risk factors such as grazing of cattle in areas with poor sanitation and disposal of manure in areas inhabited by people [3]. Thus, the possibility of maintenance and transmission

of zoonotic parasites between human subjects and livestock in the municipality could be real.
This study was aimed at determining the prevalence of endo-parasites among cattle including those with zoonotic potential and adversely affect the livestock productivity.

Materials and Methods

The study was done at Kisumu which is the third largest city in Kenya. It is a commercial and industrial centre for the Lake Victoria basin. Currently the population is estimated at 500,000 with a growth rate of 2.8% per annum. About 60% of the resident population of the municipality are involved in some form of urban agriculture and livestock keeping since 80% of Kisumu's municipal land area is rural in nature [2].

The study sites and farms were purposively selected in collaboration with the government extension and administration officers on the basis of a higher concentration of livestock keeping. These sites are shown on Fig 1 and included: Nyamasaria, Nyalenda, Obunga, Manyatta, Mamboleo and Kolando, located in Chiga, Nyalenda, Kanyakwar, Manyatta and Korando sub-locations respectively. Nyalenda, Obunga and Manyatta sites were within the urban areas while Nyamasaria, Mamboleo and Kolando were in the peri-urban area of Kisumu municipality. Nyalenda and Obunga were highly populated and are mainly regarded as slums [10]. In each study site, the farmers were randomly selected from a list prepared from the previous vaccination campaigns by the veterinary office in Kisumu. The animals included in the study were only those not de-wormed in the previous three months. From each farmer, a maximum number of three animals were sampled to allow for an almost equal distribution of sampled subjects. The sampled cattle were stratified by sex and age so that those up to one year were classified as calves while over one year up to three were categorized as young stock and the ones older than three years categorized as adults.

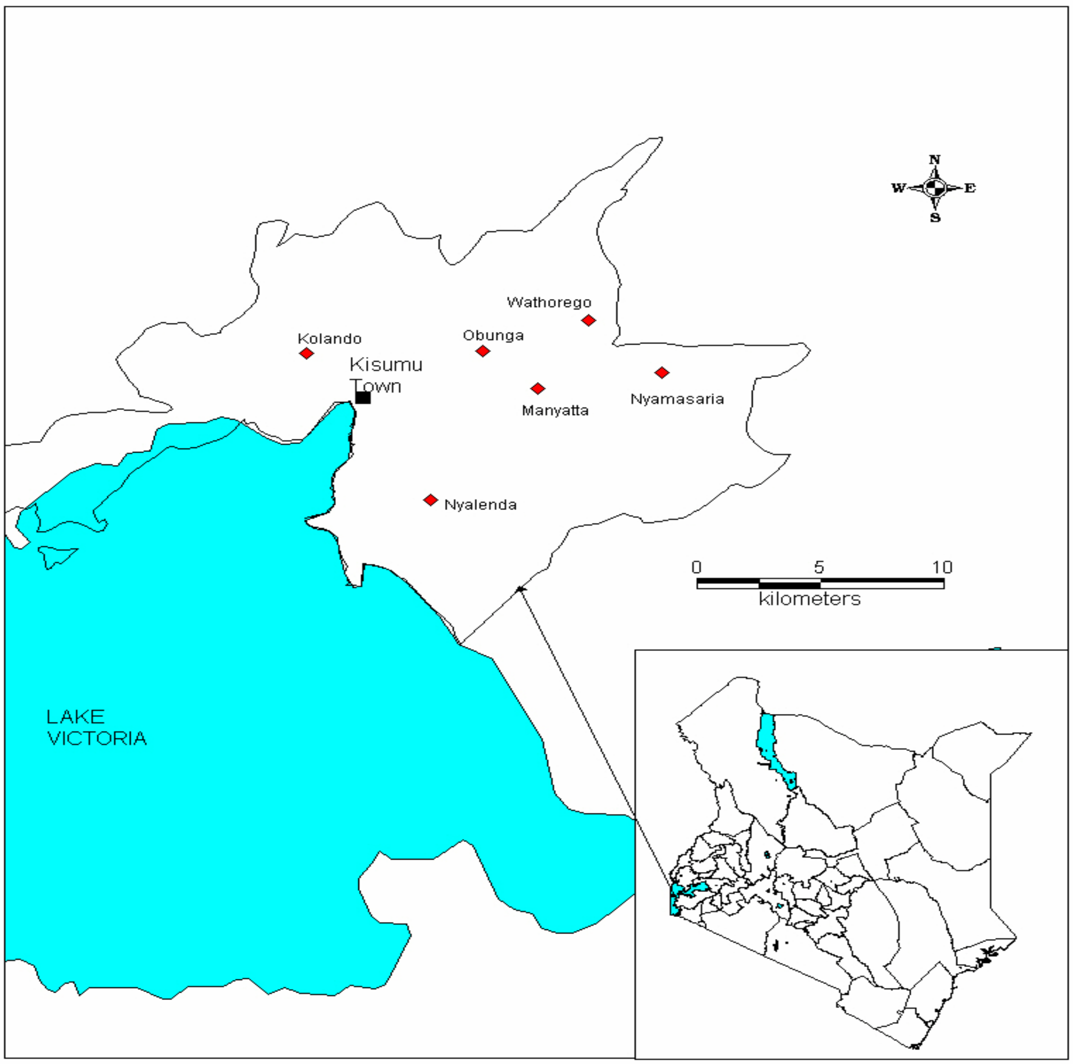
Faecal samples were collected per-rectum using plastic gloves, put into faecal pots, labeled and kept cool before transportation to the laboratory where they were quantitatively analyzed to determine the nematode eggs per gram (EPG) of faeces using a modified McMaster technique [11]. Quantification of coccidia oocysts was done as described by MAFF manual [11]. Faecal smears were also made on glass slides and examined for the presence of moving trophozoites and cysts of protozoan parasites. Faecal samples were also examined for the trematode eggs using the sedimentation technique [11]. Morphological and colour differences were used to distinguish between Fasciola and Paramphistomum eggs.

Data was entered into Ms Excel®, 2003 (Microsoft corporation, USA) and analysis was conducted using Ms Statview® (SAS Institute Inc, 1995-1998, Cary, NC, USA). Descriptive statistics were calculated and presented as tables and graphs. The prevalence (p) of cattle harbouring each parasite was calculated as $p = d/n$, where d is the number of cattle diagnosed as having a given parasite at that point in time and n = number of cattle at risk (examined) at that point in time. The association between independent factors (age, sex, body condition and area of origin) and continuous dependent variables (EPG, OPG and trematode intensity) was calculated using one way analysis of variance (ANOVA). The intensity of infection was measured as EPG/OPG and for trematodes, +1 = 1 egg per field; +2(2-5), +3(6-10) and +4 (>10/field). These observations were made at microscope objective X10. The association between the independent factors and the prevalence of the various parasites was evaluated using Chi-square statistic ($\chi 2$). The correlations between the occurrence and intensity of the parasites was undertaken using the Pearson partial correlation (rho, r). In all the analysis, confidence level was held at 95%, and $p<0.05$ was set for significance.

Results

A total of 364 cattle were sampled and were mainly kept for generation of income and domestic consumption (97% and 59% respectively). Ninety eight percent (98%) of the cattle were indigenous, while the 2% cattle were Friesian and Aryshire breeds. All the livestock, apart from exotic breeds,

Fig. 1: Location of the study sites randomly selected within Kisumu Municipality and and the Peri-urban area.



were grazed in the open spaces, along the roads and solid waste dump sites in the municipality. The few exotic breeds were kept in zero-grazing units.

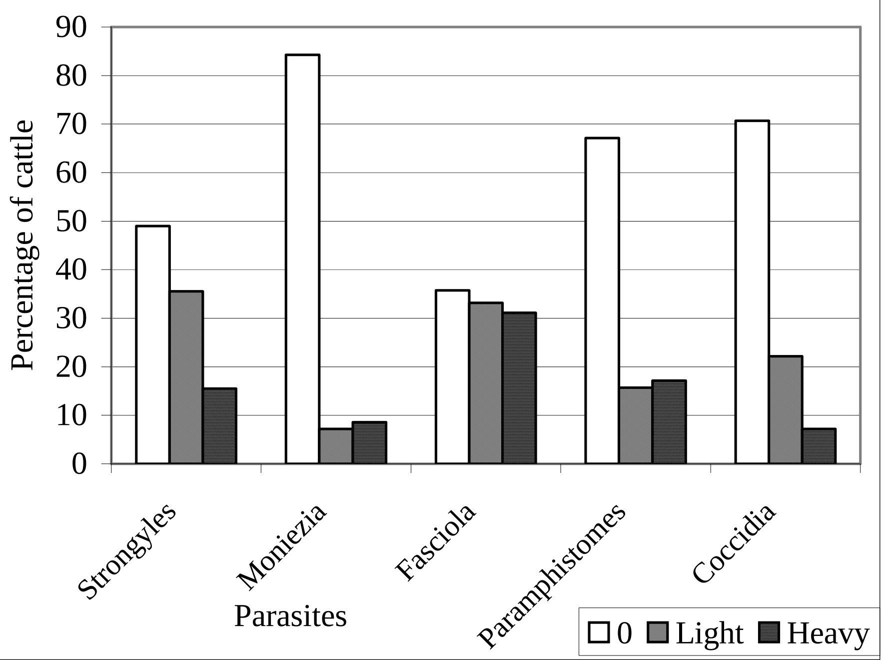
In order of importance, the nematode parasites observed in cattle as seen from Table 1 were strongyles (51%), *Strongyloides papillosus* (2%), *Toxocara vitulorum* (2%) and *Trichuris* species (2%). Of the animals infected with strongyles, 36% had light infection while only 15% had EPG of more than 500 (Fig 2).

The trematodes observed were *Fasciola* and *Paramphistomum* species, with a prevalence of 64.2% and 31.3%, respectively. The prevalence of cattle excreting any species of trematodes was 75%. The percentage of animals with +1, +2, +3 and +4 intensities of Fasciola infection were 33%, 14%, 16%, and 1% respectively.

Table 1: The prevalence and intensity of parasites excreted by cattle in Kisumu municipality

Parasite Type	N	Positive (%)	EPG/OPG Intensity		
			Mean	SE	Range
Strongyles	349	51	296	37.3	0-8300
S. papillosus	349	2	19	12.4	0-3600
T. vitulorum	349	2	2	0.6	0-100
Trichuris species	349	2	4	1.8	0-400
Any nematode	349	51	306	37.5	0-8300
Monieza species	349	16	114	20.4	0-2600
Fasciola species	344	64	-	-	0 - +4
Paramphistomum species	344	33	-	-	0 - +4
Coccidia species	349	30	124	17.5	0-3000
Entamoeba species	364	83	-	-	-
B. coli	364	7	-	-	-
Giardia species	364	14	-	-	-

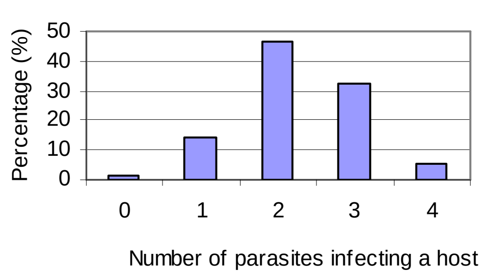
Fig 2. Intensity of shedding various parasite eggs/oocysts in cattle



For paramphistomes, the proportion of animals with +1, +2, +3 and +4 intensities were 15%, 8%, 8% and 1% respectively. The only cestode observed in the cattle was *Moniezia* species with a prevalence of 16 % of which 9% had light infections (Fig 2). The gastrointestinal protozoan parasites observed in the study included *Entamoeba* species, coccidian species, *Giardia* species, and *Balantidium coli* with a prevalence of 83%, 30%, 14% and 6.6%. Majority of cattle had light infection with coccidian parasites (Fig 2).

The animals were grouped according to the type of parasites they were shedding (nematodes, cestodes, trematodes, and protozoa). Most cattle were excreting two or three parasites types at the time of sampling (Fig. 3). Very few animals excreted 4 parasite types. There were significant association between strongyle EPG and prevalence of paraphistosomes (r=0.104, p=0.05); prevalence of strongyle and prevalence of coccidia (r=0.108, p=0.05). Other significant associations were between prevalence of moniezia and prevalence of paraphistomes (r=0.112, p=0.04), coccidia (r=0.131, p=0.02), and *Giardia*, (r=-0.095, p=0.08). The prevalence of Fasciola was significantly associated with prevalence of paraphistomes (r=0.147, p=0.008) and *Giardia* species (r=-0.111, p=0.044). For coccidia significant associations observed were between coccidia EPG and prevalence of *Giardia* species (r=-0.114, p=0.039), coccidia intensity and *Giardia* species (r=-0.108, p=0.05), coccidia prevalence and *Giardia* (r=-0.144, p=0.0093). The prevalence of *B. coli* was significantly associated with that of *Giardia* (r=0.140, p=0.01).

Fig 3. Percentage of cattle passing out a given number of endoparasites in faeces



Calves had significantly higher prevalence (χ^2=8.84, p=0.0002), mean EPG (EPG=: F=5.4, p=0.0047) and level of intensity (χ^2=11.2, p<0.0001) than young stock and adults. There was no significant (p>0.05) difference between the prevalence, mean EPG and level of intensity of strongyles between adults and young stock. Age was not significantly associated with measured parameters of *Trichuris* species and *Strongyloides* species. However, calves had significantly (χ^2=5.7, P=0.004) higher prevalence of *T. vitulorum* than either adults or young stock.

Male cattle had significantly higher strongyle intensity (χ^2=13.6, p=0.0002), prevalence (χ^2=8, p=0.005) and mean EPG (F=3.7, p=0.04) than female ones. Indigenous cattle had higher prevalences (χ^2=4.1, p=0.04) and mean EPG (F=3.2, P=0.076) than exotic ones. Cattle with good body condition had lower prevalence (χ=5.8, p=0.02), mean EPG (χ=4.7, p=0.01) and level of intensity (χ=12.7, p=0.0004) of strongyles. Area of origin was significantly associated with strongyle intensity levels (F=2.97, p=0.01), but not with strongyles prevalence (F=0.57, p=0.72) and mean EPG (F=1.86, p=0.1).

The highest mean EPG and prevalence of Moniezia species were recorded in calves and adults, respectively. However, comparisons across groups for these variables were not significant (p>0.05). The local breeds of cattle had higher prevalence and mean EPG of Moniezia than the exotic breeds, although the differences were not significant (p>0.05). Male animals had a higher prevalence (χ2=0.308, p=0.58) and mean EPG (F=0.79, p=0.38) than females. Animals with poor body condition had higher prevalence (χ=2.3, p=0.13) and mean EPG (F=6.3, p=0.01) of *Moniezia* species than those with good body conditions. Cattle from Wathirigo had highest mean EPG and prevalence of *Moniezia* species than all the other areas, and statistically, the area of origin was significantly (p<0.0001) associated with both the mean EPG and prevalence of *Moniezia* species.

In descending order, the prevalence and intensity of *Fasciola* species and Paramphistomes was highest in adults, young stock and calves. Age was significantly associated with high prevalence (χ =10.4, p=0.005) and intensity (χ=6.5, p=0.04) of *Fasciola*. Calves had significantly (p<0.05) lower prevalence of *Fasciola* than young stock and adults while for intensity, only among adults and calves were levels significantly different ($p=0.01$). Age was significantly ($\chi = 23.9$, $p<0.0001$) associated with paramphistomes prevalence, with the reported prevalences of each age group of cattle being significantly ($p<0.05$) different from each other. Similarly, age was significantly ($\chi = 14.3$, $p=0.0008$) associated with intensity of paramphistomes, with adults being significantly higher than calves ($p=0.0004$) and young stock ($p=0.02$). The intensities in latter two groups (calves and young stock were not significantly different ($p=0.15$). Local breed of cattle had higher burdens of the both *Fasciola* and paramphistomes. Breed was not significantly ($p<0.05$) associated with the measured variables of Fasciola. However, significantly higher prevalence ($\chi=14.2$, $p=0.0002$) and intensity ($\chi=6.1$, $p=0.01$) of paraphistomes were observed in the indigenous cattle than exotic ones. Female animals had higher prevalences, mean EPG and intensities of the trematodes than male animals, but the differences were not significant ($p>0.05$). Body condition was significantly associated with prevalence of Fasciola ($\chi=3.4$, $p=0.04$) and any trematode ($\chi=7.3$, $p=0.007$), but was not associated ($p>0.05$) with the other measured variables. Fasciola intensity was significantly ($F=8.5$, $p<0.0001$) associated with area of origin being highest in Nyalenda and lowest Nyamasaria. In descending order, prevalence of paramphistomes was highest in Wathirigo (52.8%), Nyamasaria (47.4%), Manyatta (39.1%), Nyalenda (35.7%), Kolando (5.4%) and Obunga (9.1%). Area of origin was significantly associated with prevalence ($F=8.8$, $p<0.0001$) and intensity ($F=3.5$, $p=0.004$) of paraphistomes.

The mean EPG of coccidia was significantly ($p=0.03$) higher in calves than young stock. Age of cattle was not significantly associated with prevalence ($\chi=3.1$, $P=0.2$). Exotic animals and those with poor body condition had higher coccidia burdens than animals which were indigenous or in good body condition respectively. Age, breed, sex and body condition of cattle was not significantly ($p>0.05$) associated with prevalence of *Entamoeba* species, *B. coli* and *Giardia* species. Area of origin was significantly associated with prevalence of *Entamoeba* ($F=4.3$, $p=0.0008$) and *Giardia* ($F=7.45$, $p<0.0001$) but not ($p>0.05$) prevalence of *B. coli.*

Discussion

This is the first report on the parasite infestations among cattle kept in the urban/peri-urban environment of the lakeside town of Kisumu. In this study Strongyles were reflected as the most important nematodes among the cattle sampled, a feature which has been reported in other studies in other parts of Kenya [12,13]. The strongyles, are known to depress growth rates in cattle when burdens are sufficiently high. It is clear that a substantial number of cattle had moderate to high nematode loads.

The trematodes observed in the livestock were *Fasciola* and *Paramphistomum* species but not *Schistosomum* species. Majority of the animals had light to heavy infections. Fasciolosis and paramphistosomosis are two important parasitoses in farm livestock all over the world where they cause huge losses to production [14,15]. Indeed, high prevalence of these two parasitic diseases has been observed in livestock from Kenya and Tanzania [13,16]. The enviroment around Kisumu has plenty of water marshes which favour the presence of the water snails, the intermediate hosts for these trematodes. Human fasciolosis has been reported from different parts of the world [17.18,19]. Infections are thought to be acquired from ingestion of infective metacercarie encysted on water growing plants such as watercress [19]. In Kisumu, there are a variety of water growing edible greens and the possibility of human infections requires investigation especially considering that, sanitation in many parts of this Lakeside urban center is poor and drinking water at times subject to contamination by faeces of animal origin including bovines. Though Schistosome eggs were not encountered, medical records show bilharziasis as prevalent and hence cattle could be the reservoirs of these zoonotic trematodes.

The only cestode observed in the cattle was Moniezia species. The occurrence of this parasite elsewhere in tropics and Kenya in particular has been described. However, the economic and pathogenic significance of the parasite is not well understood.

High prevalence of coccidiosis has been reported in Kenyan livestock possibly due to the favorable climate in terms of moisture and warmth [13,20].

Although, the parasites were not further characterized to the species, some *Eimeria* species eg., *E. bovis* and *E. zuernii* are known to be most pathogenic, being associated with acute and chronic disease.

Other protozoan parasites observed in the study included *Entamoeba* species, *Balantidium coli* and *Giardia* species. The prevalence of *Entamoeba* was high (77-87%). For *B. coli* trophozoites prevalence ranged between 2 and 6%. All the three parasites have both pathogenic and zoonotic importance. It would be important to further characterize *Entamoeba* species since *E. histolytica* is known to be pathogenic to man. In recent years, the zoonotic importance of *B. coli* and *Giardia* species has been noted [21,22]. These parasites are potential pathogens especially to immunocompromised humans particularly those suffering from HIV/AIDS. In Kisumu, the prevalence of HIV/AIDS is relatively high and it would therefore be important to determine the prevalence of these parasites in humans and their origin.

For a rational and sustainable helminth control programme, comprehensive knowledge on the epidemiology of parasites, and how they relate with a given climate and management is a pre-requisite. It would be important to determine the relationship between the occurrence of the parasite and environmental factors.

Acknowledgements

The authors are very grateful to VicRes who financially supported the project and to both the University of Nairobi and Kenya Agricultural Research Institute for providing the laboratory facilities. The technical and logistical support given by the Laboratory staff at the University of Nairobi and the field staff at the Kisumu Veterinary office is highly appreciated.

References

1. **Ishagi ,N., Ossiya S., Aliguma, L., Aisu, C. 2002**. Urban and peri-urban livestock keeping among the poor in Kampala City. Ibaren Konsultants, Kampala, Uganda.
2. **Mireri, C., Atekyereza, P., Kyessi A., Mushi, N. 2007**. Environmental risks of urban agriculture in the Lake Victoria drainage basin: A case of Kisumu municipality, Kenya. *Habitat International* , 31: 375–386.
3. **Kagira J. M., Kanyari P. W. N. 2008**. Questionnaire survey on urban and peri-urban livestock farming practices in Kisumu Municipality, Kenya. *Journal of South African Veterinary Association.* In Press.
4. **Kagira J. M., Kanyari P. W. N. 2001**. The role of parasitic diseases in causing mortalities in small ruminants in a highly productive area of Central Province, Kenya. *Journal of South Africa Veterinary Association*, 72: 147-149.
5. **Mukhebi, A. W., Shavulimo, S. R., Ruvuna, F., Rurangirwa, F. 1985**. Economics of parasite control among goats in Western Kenya. In: Proceedings of the Fourth Small Ruminant - Collaborative Research Support Programme Kenya, Kakamega, Kenya, March 11 - 12 , pp. 185-189.
6. **Harrison, L.J.S., Hammond, J.A., Sewell, M.M.H. 1996**. Studies on helminthosis at the CTVM. Tropical Animal Health and Production, 28: 23 – 39.
7. **Kithuka J.M., Maingi N., Njeruh F.M., Ombui J.N. 2005**. The prevalence and economic importance of bovine fasciolosis in Kenya-an analysis of abattoir data. *Onderstepoort Journal of Veteterinary Research*, 69: 255-62.
8. **Kang'ethe E.K., McDermott B., M'Ibui G.M., Randolph T.F., Langat A.K. 2007**. Investigation into the prevalence of bovine cryptosporidiosis among small-holder airy households in Dagoretti Division, Nairobi, Kenya. *East African Medical Journal,* 84: S76-82.
9. **Omudu E.A, Amuta E.U. 2007**. Parasitology and urban livestock farming in Nigeria: Prevalence of ova in faecal and soil samples and animal ectoparasites in Makurdi. Journal of South African Veterinary Association, **78**: 40-45.
10. **nited Nations Development Programme 1996**. Urban agriculture, food, jobs and sustainable cities. Publication series for Habitat II. UNDP, New York.
11. **Ministry of Agriculture, Fisheries and Food (MAFF) 1986**. Manual of Veterinary Parasitological Laboratory Techniques, 3rd edition., reference book 418. HMSO, London.
12. **Gatongi P.M., Gathuma J.M., Munyua W.K. 1987**. The prevalence of gastrointestinal

nematodes in cattle in Tetu Division of Nyeri District, Kenya. *Bulletin of Animal Health and Production in Africa*, 35: 294-297.

13. **Waruiru R.M., Kyvsgaard N.C., Thamsborg S.M., Nansen P., Bogh H.O., Munyua W.K., Gathuma J.M. 2000**. The prevalence and intensity of helminth and coccidial infections in dairy cattle in Central Kenya. *Veterinary Research Communication*, 24: 39-53.
14. **Mage C, Bourgne H, Toullieu JM, Rondelaud D, Dreyfuss G. 2002**. *Fasciola hepatica* and *Paramphistomum daubneyi*: changes in prevalences of natural infections in cattle and in *Lymnaea truncatula* from central France over the past 12 years. *Veterinary Research,*33:439-47.
15. **Wamae L.W., Hammond J.A., Harrison L.J., Onyango-Abuje J.A. 2004.**Comparison of production losses caused by chronic *Fasciola gigantica* infection in yearling Friesian and Boran cattle. *Tropical Animal Health and Productio*,. 130:23-30.
16. **Keyyu J.D, Monrad J, Kyvsgaard NC, Kassuku A.A. 2005**. Epidemiology of *Fasciola gigantica* and amphistomes in cattle on traditional, small-scale dairy and large-scale dairy farms in the southern highlands of Tanzania. *Tropical Animal Health and Production*, 37:303-14.
17. **Torresi J; Richards M.J; Taggart G.J; Smallwood RA 1996**. *Fasciola hepatica* liver infection in a Victorian dairy farmer. *Medical Journal of Australia*, 164:511.
18. **O'Neill S.M; Parkinson M; Strauss W; Angles R; Dalton J.P.1998**. Immunodiagnosis of *Fasciola hepatica* infection (fascioliasis) in a human population in the Bolivian Altiplano using purified cathepsin L cysteine proteinase. American *Journal of Tropical Medicine and Hygiene*, 58:417-423.
19. **Hughes A.J; Spithill, T.W; Smith R.E; Boutlis C.S; Johnson P.D.R. 2003**. Human fasciolosis acquired in an Australian urban setting. *Medical Journal of Australia*, 178: 244-245.
20. **Kanyari P.W.N. 1993**. The relationship between coccidial and helminth infections in sheep and goats in Kenya. *Veterinary Parasitology*, 51:137-41.
21. **Thompson R.C.A 2000**. Giardiasis as a re-emerging infectious disease and its zoonotic potential. *International Journal for Parasitology*, 30: 1259–1267.
22. **Thompson, R.C.A. 2004**. The zoonotic significance and molecular epidemiology of *Giardia* and giardiasis. *Veterinary Parasitology*, 126: 15–35.