



**Journal of
Veterinary Medicine and
Animal Health**

**Volume 8 Number 10 October, 2016
ISSN 2141-2529**



*Academic
Journals*

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Full Length Research Paper

Disease management and biosecurity measures of small-scale commercial poultry farms in and around Debre Markos, Amhara Region, Ethiopia

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Received 15 August, 2016; Accepted 13 September, 2016

This cross-sectional study was carried out to assess disease management and biosecurity measures of small scale commercial poultry farms by structured questionnaire through personal interview. The data was analysed by χ^2 and t-test, one way analysis of variance and general linear model by SPSS software. The result shown that, only 38.8% of the producers' suspects Coccidiosis was the frequently occurred disease in the farm. Some of the producers (30.6%) suspect the cause of the disease might be environmental problem, 24.5% management problem, and 12.2% both environment and management. The most leading symptoms of diseases that occurred in the study area were ruffled feather (15.5%), loss of appetite (15.1%), depression (12.6%), diarrhoea (9.7%), and others. About 79.6% of the farms had close relation with the veterinarian and consult about disease management. Only 12.2% of the farms vaccinate NCD, 49% NCD and Gumboro, 28.6% NCD, Gumboro and fowlbox and the rest 10.1% vaccinate their chicks for NCD, Gumboro, fowlbox, Fowl cholera/typhoid and Marix disease. Biosecurity measures were very crucial in the poultry farms. About 63.3% of the producers dressed on protective cloth (tuta), only 8.2% of the producers wear hand gloves. About 77.6% of the producers used the foot path in front of their farm entrance. Prevention and treatments were the major mechanisms for controlling measure of disease and the mortality percentage of chicks was only 4.7%. From this study, it could be concluded that better disease management and biosecurity measures are required to attain better poultry production

Key words: Biosecurity, disease, mortality rate, symptoms, vaccination.

INTRODUCTION

It is essential that the flock is in good health to achieve their performance potential; however, one of the

important reasons for failure in the poultry industry is disease. Various types of poultry diseases can caused

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serious loss in the poultry farming business. Diseases occur due to lack of proper care and management, inadequate nutritious feeding and some other factors. Generally, diseases can be defined as 'changes of general or usual physical condition'. Almost all types of animal can be affected by different types of disease in their lifetime. Poultry are not exception; they also get affected by numerous diseases. In small scale commercial farms, coccidiosis was identified as the most common disease (Singla and Gupta, 2012), followed by infectious bursal disease (IBD) and Newcastle disease (NCD) (Safari et al., 2004; Akidarju et al., 2010). However, infectious bronchitis, Marek's disease, fowl cholera, fowl pox, avian encephalomyelitis are also the major poultry diseases which affects the flock in the farm (Jacob et al., 1998; Ahmed et al., 2011; Hailu, 2012). Hailu (2012) reported that Newcastle disease, infectious bursal disease and Marek's disease are among major viral diseases of chickens in Ethiopia. Diseases can be caused by viruses, mycoplasma, bacteria, fungi, protozoa and parasites (Sandhu et al., 2009; Hamra, 2010).

The most common symptoms of disease in small scale poultry farms were enteritis (Diarrhea), ruffled feather, depression (dejection), respiratory rales/panting, coughing, drooling saliva, swelling of head and eyes, torticollis (twisting of the neck) and others (Akidarju et al., 2010). Developing and practicing daily biosecurity procedures as best management practices on poultry farms will reduce the possibility of introducing infectious diseases. Controlling diseases from the beginning is important for the success of the operation (Moblely and Kahan, 2007). The diseases can be reduced by proper sanitation on the farm, biosecurity measures and vaccination of the chickens (Hamra, 2010). However, the management of disease and biosecurity measures in small scale commercial poultry farms in and around Debre Markos had not been studied yet and there was no documented evidence. Therefore, to get a piece of information and to take remedial measures for successful poultry production, this study was done to assess the management of disease and biosecurity measures of small scale commercial poultry farms in and around Debre Markos.

METHODOLOGY

The study area

This study was conducted in and around Debre-Markos, Ethiopia from September, 2015 to May, 2016. Debre-Markos is located at 300 km from Addis Ababa in Northwest of the country and 265 km Southeast of Bahir Dar, capital of Amhara Region. The altitude ranges from 500 to 4154 m above sea level. The annual rainfall ranges from 900 to 1800 mm and a minimum and maximum temperature of the area is 7.5 and 25°C, respectively.

Study population

All small-scale poultry farm owners who started by their own

initiation and organized by small and micro enterprise offices in and around Debre Markos were considered as the study population.

Research design

Cross-sectional study was carried out to assess management of disease and biosecurity measures of small-scale commercial poultry farms.

Data collection and analysis

Data were collected by the use of pretested structured questionnaire through personal interview method from heads (owner of the farm) and leaders of the farm (organized in small and micro enterprise offices) to generate information on management of disease and biosecurity measures in small-scale commercial poultry farms.

Statistical analysis

Data generated was entered into SPSS version 20 and analyzed using descriptive statistics with emphasis on frequency, mean and percentages. Analysis of variance (ANOVA) and t-test was computed to know the significant difference of variables. Chi-square (χ^2) for association values was computed to determine the relationships between the categorical variables.

RESULTS

Socio demographic characteristics

The socio demographic characteristics of small scale poultry farmers are presented in Table 1. Sex had a significant effect ($P < 0.05$) on operation of small scale poultry farms. There was no significant ($P > 0.05$) difference between married and unmarried in small scale poultry operation. The educational level had highly significant effect ($P < 0.05$) on running poultry farming. About one third (36.7%) of small scale farming was run by first degree poultry producers. More than half (57.1%) of the producers had no experience and the rest 42.9% of the producers run their farms with experiences. Family size had a significant effect ($P < 0.05$) on small scale poultry production. Only 79.6% of the producers had 1 to 3 family sizes. Exactly 79.6% of the poultry producers were engaged fully in poultry production and the rest 20.4% had it as secondary occupation in and around Debre Markos small scale commercial poultry farms.

Flock size of chicks in small scale poultry farms in and around Debre Markos

The flock size and breeds of chicks in small scale poultry farms in and around Debre Markos is presented in Table 2. The mean flock size per farm was 844.3; however, the flock size was significantly ($P < 0.05$) influenced by sex of birds. Female chicks were higher ($P < 0.05$) than male

Table 1. Socio demographic characteristics of small scale poultry farms in and around Debre Markos.

Variables		N=49	%	χ^2	P-value
Sex	M	41	83.7	10.694	< 0.001*
	F	8	16.3		
Age	<15	1	2.0	97.204	< 0.001*
	15-30	42	85.7		
	31-45	5	10.2		
	46-60	1	2.0		
Marital Status	Married	22	44.9	0.510	0.475
	Unmarried	27	55.1		
Religion	Orthodox	48	98	45.082	< 0.001*
	Muslim	1	2		
	Others	0	0		
Ethnic Group	Amhara	49	100	1.000	< 0.001*
	Others	0	0		
Occupation	Poultry prod	39	79.6	17.163	<0.001*
	Others	10	20.4		
Family size	1-3	39	79.6	49.143	<0.001*
	4-6	9	18.4		
	7-9	1	2.0		
Presence of experiences	Yes	21	42.9	1.000	0.317
	No	28	57.1		
Experience years	new	28	57.1	23.551	<0.001*
	1-3	20	40.8		
	4-6	1	2.0		
Educational level	5-8 grade	4	8.2	10.694	0.030*
	9-10 grade	8	16.3		
	11-12 grade	9	18.4		
	Diploma	10	20.4		
	Degree	18	36.7		

*Significant effect at $P < 0.05$.

chicks. The flock was composed of four breeds of chicks like Bovans brown (egg type), Bovans white (egg type), Koekoek (dual) and Sasso T44 (dual). The flock size was not statistically ($P > 0.05$) affected by breed. However, 71.4% of the producers kept Bovans brown.

Poultry disease and prevention mechanism in small scale poultry farms

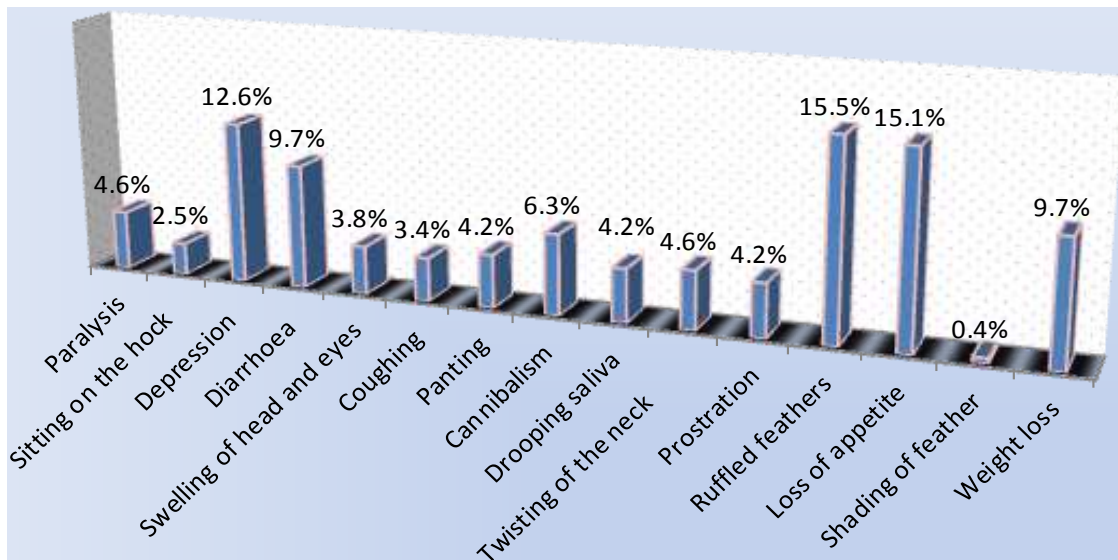
Poultry disease and prevention mechanism are in Table 3 Only 38.8% of the producers suspected the frequently occurring disease in the farm was coccidiosis and the

other 61.2% of the producer did not know which type of disease occur in their farm. However, there was no accustomed record of the disease that occurred. Some of the producers (30.6%) reported that the cause of the disease might be environmental problem, 24.5% of the producers replied that the cause of the disease might be management problem. About 12.2% reported both environment and management problem. The other 24.5% did not know the cause of the diseases in their farms. There was a significant ($P < 0.05$) difference in the experiences of disease outbreak. About 91.8% of the producers did not have any experience on disease outbreak and report of the disease outbreak.

Table 2. Flock size and breeds of chicks in small scale poultry farms in and around Debre Markos.

Variables	N (%)	Mean (SEM)
Flock size	49(100)	844.3(98.257)
Sex	Female chicks	49(100)
	Male chick	13(26.5)
Breed	Bovans brown (egg type)	35(71.4)
	Bovans white (egg type)	2(4.1)
	Koekoek (dual)	9(18.4)
	Sasso T44 (dual)	3(6.1)

N (%) describes percent of producers; SEM-standard error of mean, means with the different letter of superscript in the same column did differ significantly ($P < 0.05$).

**Figure 1.** Symptoms seen in small-scale poultry farms in and around Debre Markos.

However, prevention and treatments were the major mechanisms for controlling measure of the disease. The immediate measures of sick birds were isolation and treating them until recovery. More than half of the producers treated their chicks by themselves by purchasing Amprolium and oxytetracycline from nearby veterinary pharmacy. If a disease was severe, all the producers called veterinarian for treatment when the birds are sick and among them, about 81.6% of the producers had close relationship with veterinarians. All the producers vaccinated their chicks either twice, thrice, fourth and more than fourth. Majority of the producers (46.9%) vaccinated their chicks more than four times. About half (49%) of the producers vaccinated for Newcastle disease and Gumboro. About 98% of the producers adhered to the vaccination schedule; however, there was no any significant difference ($P > 0.05$) in

differentiation the name of the vaccine to be given for what type of disease. There were no significant ($P > 0.05$) difference in the cost of the vaccine, thus, 40.8% of the respondents said that the purchasing price of the vaccine was optimum price.

The mortality percentage of chicks in small scale commercial poultry farms was only 4.7% at 1 to 3 weeks of age. According to the producers reply, the highest mortality was recorded during long rainy season and their mortality was sporadic. The cause for mortality was transportation stress (51%) and overcrowding (32.7%) due to the disturbance of the light.

The major symptoms of disease in small scale commercial poultry farms are presented in Figure 1. The most leading symptoms of diseases were ruffled feather (15.5%), loss of appetite (15.1%), depression (12.6%), diarrhoea (9.7%), weight loss (9.7%), cannibalism (6.3%),

Table 3. Poultry health and disease in small scale poultry farms in and around Debre Markos.

Variables		N	%	χ^2	P-value
Do you vaccinate your chicken Vaccination of the disease	Yes	49	100	19.000	<0.001*
	NCD	6	12.2		
	NCD ¹	24	49.0		
	NCD ²	14	28.6		
	NCD ³	5	10.2		
Frequency of vaccination	Once	0	0	12.959	0.005*
	Twice	10	20.4		
	Thrice	7	14.3		
	Four times	9	18.4		
	More than four times	23	46.9		
Adherence of vaccination schedule	Adhered	48	98	45.082	<0.001*
	Non adhered	1	2		
Immediate measure for sick birds observed	Isolation and treat them until recovery	49	100		
Experiences for disease outbreak	Yes	4	8.2	34.306	<0.001*
	No	45	91.8		
Reporting of disease out break	Yes	4	8.2	34.306	<0.001*
	No	45	91.8		
Type of disease frequently occurred	I know(Coccidiosis)	19	38.8	2.469	0.116
	I don't know	30	61.2		
Do you know the name of vaccine	Yes	26	53.1	0.184	0.668
	No	23	46.9		
Close relation with the veterinarian	Yes	39	79.6	17.163	<0.001*
	No	10	20.4		
Accustomed to inform for vaccine/treatment	Yes	40	81.6	19.612	<0.001*
	No	9	18.4		
Time of recovery after treatment	1-3 days	30	61.2	17.184	<0.001*
	4-6 days	9	18.4		
	No recovery	10	20.4		
In what case you call veterinarian	at sick	49	100		
Accustomed to treat your chick by your own	Yes	27	55.1	0.510	0.475
	No	22	44.9		
Cost of vaccine	Cheap	16	32.7	1.510	0.470
	Medium	20	40.8		
	Expensive	13	26.5		
Accustomed to record the disease	Yes	0	0		
	No	49	100		
Presence of isolation room	Yes	49	100		
	No	0	0		

Table 3. Cont'd.

What could be the causes of infection	Management	12	24.5	8.653	0.070
	Environment	15	30.6		
	Both	6	12.2		
	I do not know exactly	12	24.5		
	No disease occurrence	4	8.2		
Major control measure of disease	Prevention and treatment	49	100		
Highest mortality age	Starter (1-3 weeks)	49	100		
Season of mortality	Long dry season (October to January)	3	6.1	37.735	<0.001*
	Long rainy season (June to September)	46	93.9		
Reasons of mortality	Transportation stress	25	51.0	26.184	<0.001*
	Overcrowding due to light	16	32.7		
	Cannibalism	2	4.1		
	Unclear	6	12.2		
Type of mortality	Sudden	14	28.6	9.000	0.003*
	Sporadic	35	71.4		
Mortality (%)			4.7		
Survival (%)			95.3		

NCD- Newcastle disease, ¹Gumboro, ²Gumboro, fowlbox, ³Gumboro, fowlbox, Fowl Cholera/Typhoid/, Marix disease). *Significant difference (P<0.05) in the same column in Chi square test.

Table 4. Biosecurity of small-scale poultry farms in and around Debre Markos.

Variables		N	%	χ^2	P-value
Presence of foot path	Yes	38	77.6	14.878	<0.001*
	No	11	22.4		
Wearing of protective cloth	Yes	31	63.3	3.449	0.063
	No	18	36.7		
Using of hand gloves	Yes	4	8.2	34.306	<0.001*
	No	45	91.8		

*Significant difference (P<0.05) in the same column with Chi square test.

paralysis (4.6%), twisting of necks (4.6%) and others.

Biosecurity measures of small-scale commercial poultry farms

Biosecurity of small-scale poultry farms in and around Debre Markos is presented in Table 4. There was significantly higher (P<0.05) using of the foot bath to protect the entrance of microorganisms in the farm. About 77.6% of the producers have used the foot path in front of their farm entrance like formalin and berekina. Only 63.3% of the producers dressed on protective cloth (tuta);

however, 91.8% of the producers did not use hand gloves.

DISCUSSION

Disease and symptoms in small scale commercial poultry farms

Almost all the producers did not know the type of disease that occurred in their farms and were not accustomed to recording the disease that occur; however, few of the

producers (38.8%) reported Coccidiosis was the frequently occurring disease in the study area. Almost similar result was reported by Nusirat et al. (2012) who noted that about 33.3% of the producers reported that coccidiosis was the most common disease outbreak in farms, followed by IBD (24.2%) and NCD (21.2%) in Ilorin, Kwara State, Nigeria. Proportional mortality rates due to coccidiosis were 14.5 and 13.3% in small scale and large scale poultry farms, respectively (Safari et al., 2004).

With respect to the cause of the disease in the study area, 30.6% of the producers suspect environmental problem, 24.5% management problem, and 12.2% both environment and management. Jones et al. (2005) reported that poor management practices and environmental variation (temperature and relative humidity) were the cause of the disease and adversely affected the health of the flock. Reiter and Bessei (2000) emphasized the importance of local variation in temperature and humidity affects the birds' health. The management practices especially poor health care and keeping the birds beyond standard rearing period affects the flock (Rahman, 2015). Weather or poor management practices also cause the disease and affect the flock in the farm (Akidarju et al., 2010). Key factors that can increase the risk of disease include the number of birds on the farm, whether or not keeping other species of bird, not using all in and out management system, feed type and source, stress levels, breed type and so on (Anna, 2011).

The most leading symptoms of diseases in the study area were ruffled feather (15.5%), loss of appetite (15.1%), depression (12.6%), diarrhoea (9.7%), weight loss (9.7%), cannibalism (6.3%), paralysis (4.6%), twisting of necks (4.6%) and others. Almost similar result was reported by Akidarju et al. (2010) in Maiduguri arid zone, Nigeria.

About 91.8% of the producers did not have an exposure of disease outbreak and reported it to veterinarians in the study area. Almost similar result was shown by Akpabio et al. (2014) who reported that about 74% of the producers did not report any disease outbreak, while 26% of the farmers reported disease outbreaks in small scale commercial poultry farms in Kaduna State, Nigeria. Nusirat et al. (2012) also noted that the producers reported 33.3% coccidiosis, 24.2% IBD and 21.2% NCD as a disease outbreak in Ilorin, Kwara State, Nigeria. About 79.6% of the farms had close relationship with the veterinarian and consult about disease management in the study area. In contrast, Nusirat et al. (2012) reported that 42.1% of the respondents routinely consulted veterinarians in Ilorin, Kwara State, Nigeria. A good disease prevention program should be available for the newly introduced chicks to avoid any future losses (Hamra, 2010). Thus, prevention and treatment were the major mechanisms for controlling measure of disease in the study area. Mobley

and Kahan (2007) reported that controlling diseases from the beginning is important for the success of the operation. More than half of the producers can treat their chicks by their own by purchasing Amprolium and oxytetracycline from nearby vet pharmacy. If a disease was severe, all the producers were accustomed to calling veterinarian for treatment and among them about 81.6% had close relationship with veterinarians. Muhammad et al. (2010) reported that only 28.8% consulted a veterinarian for diagnosis and treatment, and the other 71% self-diagnosed the problems and instituted treatment which included vitamin supplementation or antimicrobial therapy, with enrofloxacin and gentamycin being the most popular drugs used in Jos, Central Nigeria. All producers had an isolation room for sick birds. However, Birhanu et al. (2015) reported that about 76% of the producers had isolation pen for diseased chicken in and around Mekelle. Almost, all in and out management system was done in the study area; however, Birhanu et al. (2015) reported that only 24% of the farms were practicing all in and out management system in and around Mekelle Ethiopia.

Vaccination in small scale commercial poultry farms

All small scale commercial farms in the study area were accustomed to vaccinating their chicks either twice, thrice, four times and more than that. Majority of the producers (46.9%) vaccinate their chicks more than four times. Only 12.2% of the farms vaccinate NCD, 49% NCD and Gumboro, 28.6% NCD, Gumboro and fowlbox and the rest 10.1% vaccinate their chicks for NCD, Gumboro, fowlbox, Fowl cholera/typhoid and Marix disease. Similar result was reported by Muhammad et al. (2010), all farmers (100%) vaccinated their flocks against infectious bursal disease (Gumboro) in the first week in Jos, Central Nigeria. However, Bereket et al. (2014) reported that among respondents, 24% vaccinated and 76% did not vaccinate for common diseases in the area in small scale intensive poultry farms in Bahir Dar Zuria District, Ethiopia. The result was similar to the report of Nusirat et al. (2012) who reported that about 48.5% of the respondents practiced all the recommended vaccination of their birds against the preventable diseases of Newcastle Disease (NCD), Infectious Bursal Disease (IBD), Fowl Cholera and Fowl pox in Ilorin, Kwara State, Nigeria. Birhanu et al. (2015) reported that about 84% of the farmers use vaccine for prevention of NCD, Fowl pox and Marek's diseases, whereas 80% of them use prophylactic antibiotics for prevention of bacterial diseases in and around Mekelle, Ethiopia. About 98% of the producers adhered to vaccination schedule. In contrast, Akidarju et al. (2010) reported that 27.8% of the poultry farmers had full adherence to vaccination schedules for their chickens, as against 56.7% non-adherence in Maiduguri arid zone, Nigeria.

Mortality of chicks in small scale commercial poultry farms

The mortality percentage of chicks in the study area was only 4.7% at 1 to 3 weeks of age. According to the producers reply, the highest mortality was recorded during long rainy season and their mortality was sporadic. Similar result was reported by Geidam et al. (2006) who noted that when chicks are bought at day old, mortality should not exceed 3% by the 3rd week; loss exceeding 5% requires an investigation. Mortality percentage can reach 10% or more in the first week of age in poultry farms (Anna, 2011). Mortality rate may rise due to disease, predation or high temperature. The mortality rate of small chicks (up to eight weeks of age) is about 4%; that of growers (between 8 and 20 weeks of age) is about 15%; that of layers (between 20 and 72 weeks of age) is about 12% and the average mortality rate of a flock is 20 to 25% percent per year (FAO, 2003). The cause of mortality in the study area was transportation stress (51%), overcrowding (32.7%) due to the disturbance of the light and the rest by disease. However, Akidarju et al. (2010) reported that about one third of the producers stated that sudden mortality occurred frequently due to different diseases in small scale commercial farms in Maiduguri arid zone, Nigeria. According to Muhammad et al. (2010), the level of chick mortality was 11.4% of flock size in the first two weeks of life and the major predisposing factors associated with these mortalities appear to be chick quality, disease, stress and nutrition and other management in small scale poultry farms in Jos, Central Nigeria. Early chick mortality is associated with disease, poor management, inadequate brooding temperatures and heat stress in hot climates (Chou et al., 2004). Poor quality hatches have also been reported to increase first week mortality from 0.8 to 13% (With, 2001). The first week after hatching is known to be the highest risk period for raising chicks (Chou et al., 2004). Most farmers in Jos, Central Nigeria recognized that conditions such as stress could affect their flocks in the initial first weeks, and other management factors and the source of chicks predisposed to early chick mortality (Muhammad et al., 2010). Presence of disease, feed shortage, predators and bad weather condition/extreme weather condition were identified as the major causes of chicken mortality. Among diseases, Newcastle disease, infectious bursal diseases and coccidiosis were cited in their order of importance in Bahir Dar Zuria District, Ethiopia (Bereket et al., 2014). Temperature and ventilation in the brood house are generally considered to be significant factors for early mortality in the chicks' life (Anna, 2011). The major diseases or conditions that farmers associated with mortality included stress (25.6%), Pullorum disease (13.3%), diarrhoea (13.3%), coccidiosis (4.4%), chronic respiratory disease (CRD) (1.1%) and management causes such as overcrowding and poor ventilation (8%) in Jos, Central Nigeria

(Muhammad et al., 2010).

Biosecurity measures in small scale commercial poultry farms

Developing and practicing daily biosecurity procedures as best management practices on poultry farms will reduce the possibility of introducing infectious diseases. The risk of disease transmission between farms can be reduced through appropriate farm sitting and management. Disease outbreaks (from pathogenic bacteria and viruses) in poultry can spread between farms and significantly affect poultry growing enterprises. The risk of disease developing on a farm is influenced by many factors, including the management of litter, feed and water; disinfection of sheds; vermin removal; disposal of used litter and dead birds; and the effectiveness of biosecurity measures adopted for people and equipment entering the farm (Stephen, 2012). Biosecurity measures are very crucial in the poultry farms like wearing of protective cloths and gloves. However, in the study area, about 63.3% of the producers dressed on protective cloth (tuta), only 8.2% of them wear hand gloves and very few wear boot on their foot. Similar result was reported by Nusirat et al. (2012) who noted more than one third (35.1%) of respondents did not use any form of protective clothing in their farms, while 29.7% used outer clothing like coverall in their farms. Also, 18.9% used hand gloves as a form of protective clothing. Birhanu et al. (2015) noted that 76% of the producers used separate clothes and shoes in and around Mekelle small scale commercial poultry farms. About 77.6% of the producers used the foot path in front of their farm entrance like formalin and berekina in the study area. The result is in line with the report of Birhanu et al. (2015) who noted that about 80% of the farms applied a foot bath at the door of entrance in and around Mekelle small scale poultry farm. The result is nearly similar to that of Akpabio et al. (2014) who confirmed that 66% of the farms used foot bath in Nigeria. Small scale farms are characterized by low levels of biosecurity and are more prone to the introduction of infectious agents (Akidarju et al., 2010). About 78.95% of the producers practiced biosecurity in Ilesha West Local Government Area of Osun State, Nigeria (Adedeji et al., 2014). The reason might be lack of knowledge on the use of biosecurity measures and its benefit.

Conclusion

Almost all the producers did not know the type of disease that occurred in their farms and were not accustomed to recording the disease that occurred; however, few of the producers reported Coccidiosis. The cause of the disease might be environmental, management and both

environment and management problems. The most leading and frequently observed symptoms of diseases were ruffled feather, loss of appetite, depression, diarrhoea, weight loss, cannibalism, paralysis, twisting of necks and others. All farms were accustomed to vaccinating their chicks either twice, thrice, four times and more for NCD, Gumboro, fowl cholera, Fowl Cholera/Typhoid and Marix disease. Biosecurity measures like wearing of protective cloths and gloves, and using of the foot path in front of their farm entrance like formalin were very crucial in the poultry farms. Prevention and treatment methods were the major mechanisms for controlling measure of disease and the mortality percentage of chicks was only 4.7%.

Conflict of Interests

The authors declare that they have no conflict of interests.

ACKNOWLEDGEMENTS

The authors are especially grateful to Debre Markos University and Addis Ababa University for their financial support.

REFERENCES

- Adedeji OS, Amao SR, Alabi TJ, Opebiyi OB (2014). Assessment of Poultry Production System in Ilesha West Local Government Area of Osun State, Nigeria. *Sch. J. Agric. Vet. Sci.* 1(1):20-27.
- Ahmed A, Mijinyawa MS, Adamu AY, Suleiman AO (2011). Small holder poultry management practices and constraint among women poultry farmers in Kano State, Nigeria. *Nig. Vet. J.* (32):151-153.
- Akidarju MS, Onyemaechi EG, Dauda MG (2010). An Assessment of Some Poultry Management Practices and Disease Recognition by Poultry Farmers in Maiduguri Arid Zone, Nigeria. *World's Poult. Sci. J.* 66:285-296.
- Anna B (2011). Animal Welfare Approved. Technical paper no. 8 Available at: www.animalwelfareapproved.org.
- Bereket A, Desalew T, Shigdaf M (2014). Study on major causes of chicken mortality and associated risk factors in Bahir Dar Zuria District, Ethiopia. *Afr. J. Agric. Res.* 9(48):3465-3472.
- Birhanu H, Tehetna A, Yohannes H, Awot T (2015). Assessment of Bio-Security Condition in Small Scale Poultry Production System in and Around Mekelle, Ethiopia. *Eur. J. Biol. Sci.* 7(3):99-102.
- Chou CC, Jiang DD, Hung YP (2004). Risk factors for cumulative mortality in broiler chicken flocks in the first week of life in Taiwan. *Br. Poult. Sci.* 45:573-577.
- FAO (2003). Egg Marketing. FAO Agricultural Services Bulletin 150, Rome, Italy. pp. 1-10.
- Geidam YA, Bukar MM, Ambali AG (2006). Chick quality control: A key to sustainable poultry production in Nigeria. *Nig. Vet. J.* (27):1-6.
- Hailu M (2012). Review on major viral diseases of chickens reported in Ethiopia. *J. Infect. Dis. Immun.* 4(1):1-9.
- Hamra CF (2010). An Assessment of the Potential Profitability of Poultry Farms: A Broiler Farm Feasibility Case Study. Msc thesis submitted to the Faculty of The University of Tennessee at Martin, South Lebanon. pp. 1-43.
- Jacob JP, Butcher GD, Mather FB (1998). Vaccination of Small Poultry Flocks, University of Florida, Gainesville, P 32611.
- Jones TA, Donnelly CA, Dawkins MS (2005). Environmental and Management Factors Affecting the Welfare of Chickens on Commercial Farms in the United Kingdom and Denmark Stocked at Five Densities. *Poult. Sci.* 84(8):1155-65.
- Mobley R, Kahan T (2007). Practical Management of Health Issues in a Poultry Production System: Symptoms, Sources, and Prevention of Common Diseases, Florida A&M University, Tallahassee, Florida.
- Muhammad M, Muhammad LU, Ambali AG, Mani AU (2010). A Survey of Early Chick Mortality on Small-Scale Poultry Farms in Jos, Central Nigeria. *Int. Poult. Sci. J.* 9(5):446-449.
- Elelu N, Jaji Z, Badiru A, Olowoleni F, Ambali AG (2012). Assessment of Management and Health Practices in Some Selected Poultry Establishments in Ilorin, Kwara State, Nigeria. *Int. Poult. Sci. J.* 11(8):524-528.
- Rahman S (2015). Management of Broiler Farms in Aizawl District of Mizoram, India. *Livestock Research for Rural Development*. Available at: <http://www.lrrd.org/lrrd27/4/rahm27061.html>.
- Reiter K, Bessei W (2000). Effect of stocking density of broilers on temperature in the litter and at bird level. *Arch. Geflügelkd* 64:204-206.
- Safari M, Kinung'hi1, Getachew T, Hafez M, Hafez, Moges W, Moses K, Matthias G, Maximilian PO (2004). Assessment of Economic Impact Caused by Poultry Coccidiosis in Small and Large Scale Poultry Farms in Debre Zeit, Ethiopia. *Int. J. Poult. Sci.* 3(11):715-718.
- Sandhu BS, Brar RS, Brar APS, Sood NK, Singla LD (2009) Prevalence and pathology of parasitic gastrointestinal infections of poultry in punjab. *Indian Vet. J.* (86):1276-77.
- Singla LD, Gupta SK (2012) Advances in diagnosis of coccidiosis in poultry. In: *Veterinary Diagnostics: Current Trends*, Gupta RP, Garg SR, Nehra V and Lather D (Eds), Satish Serial Publishing House, Delhi. pp. 615-628.
- Stephen C (2012). Best Practice Management for Meat Chicken Production in New South Wales –Manual 2 (Meat Chicken Growing Management). ISBN 978 1 74256 250 6. pp. 4-20.
- Akpabio U, Kwaga JK, Kabir J, Umoh VJ (2014). Assessment of Some Poultry Management Practices in Kaduna State, Nigeria. *World J. Public Health Sci.* 3(1):1-4.
- With L (2001). Problems associated with hatching Coab500 broiler chicks in New Zealand conditions Available at: http://www.jcu.edu.au/school/bms/avpa/avpa_NZ_2001/. Accessed.

Full Length Research Paper

***In vitro* analysis of the dissolution rate of canine uroliths using *Moringa oleifera* root**

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Received 15 December, 2015; 15 September, 2016

Urolithiasis is a common disorder of humans and animals. The surgical intervention to correct the condition is expensive and alternative cheaper botanical treatments should be explored. Various botanicals have been shown *in vitro* not only to dissolve, but also inhibit urolith accretions. In this study the *in-vitro* efficacy, anti-urolithiatic potential and dissolution rate of aqueous and ethanol, chloroform, and ether extracts of *Moringa oleifera* roots on canine uroliths was investigated without simulation of *in vivo* experimentation. In the aqueous extract an average dissolution of calcium oxalate (CaO_x) was 77%. The rate of dissolution of the Calcium Oxalate (CaOx) increased linearly. However, ethanol and chloroform extracts increased both the rates of dissolution by weight and surface area linearly. The oral use aqueous extracts is considered a safe measure in treating various clinical conditions including urolithiasis in humans and animals. The dissolution rates of uroliths in organic solvents are probably associated with the presence of organic compounds unique to the *Moringa* family. The potential of using moringa extracts may prove to be an ethno-veterinary practice to address urolithiasis in animals.

Key words: Anti-urolithiatic, *Moringa oleifera*, dissolution rate, aqueous extract, magnesium ammonium phosphate (MAP), calcium oxalate (CaO_x)

INTRODUCTION

Urinary calculi, uroliths or kidney stones are accretions of solid mineral crystals within the urinary tract of human, goats and sheep and is a common clinical manifestation in the latter in Trinidad (Lans, 2001). Calculi are of many types including magnesium phosphate (MAP), calcium carbonate (CaO_x) including calcium oxalate which obstruct the passage of urine, in the ureter, dilating the obstructed ureter and renal pelvis. Clinical manifestations

of the condition in goats in Trinidad include restlessness, swishing of the tail, groaning, grunting, straining to urinate, protruded penis, and eventually rupture of the bladder as is found in other studies (Fazili et al., 2010). As urine is supersaturated, chemical moieties inhibiting of crystal formation in the urinary system may not be present in clinical cases of urolithiasis. The surgical treatments available to goat producers include urethral

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Figure 1. Size of canine calcium uroliths.



Figure 2. Canine magnesium (MAP) and calcium (CaOx uroliths).

process amputation, and perineal urethrostomy

Various alternative treatments have been experimented upon by several investigators who attempt to simulate in vitro conditions of uroliths formation with in vivo experimental studies (Grases et al., 1998). In vitro studies to dissolve or prevent uroliths formation of similar types as is found in humans include the use of aqueous leaf extracts of *Phyllanthus niruri* to dissolve CaO_x (Khare et al., 2014) using aqueous alcoholic rhizome extract of *Bergenia ciliata* to inhibit and prevent CaO_x formation in a synthetic urinary system (Saha and Verma, 2013) and using ethanolic and methanolic leaf extracts, respectively, of *Morus Alba L.* and of *Limnea procumbens* of ethylene glycol induced oxalate urolith formation, but ameliorated by these extract using Wistar rat models

(Maya and Pramod, 2014; Makasana et al., 2014). *Moringa oleifera* (Moringa or drumstick tree) root bark extracts have been found to reduce kidney elimination of calcium oxalate and calcium phosphate in propylene glycol induced hyper oxaluria also using a Wistar rat *in vitro* model (Karadi et al., 2006; Karadi et al., 2008). The results of these two experiments suggest that there is a possible use of *M. oleifera* root aqueous extracts in ameliorating the formation of these two types of kidney stones in humans and animals (Karadi et al., 2006; Karadi et al., 2008).

M. oleifera originated from the sub-Himalayan regions of Northwest India and is currently found ubiquitously in several African, Asian, South American, Central American and Caribbean Countries. In all parts, the plants have been used for herbal treatments probably because of the unique range of glycosidic compounds it contains (Anwar et al., 2007). Various ethno botanical concoctions from plant parts have been used for cardiac and circulatory conditions, and for medical conditions requiring interventions of antitumor, antipyretic, antiepileptic, anti-inflammatory, antiulcer, antispasmodic, diuretic, antihypertensive, cholesterol lowering, antioxidant, anti-diabetic, hepatoprotective, antibacterial and antifungal, for rural communities worldwide (Anwar et al., 2007; Sharif et al., 2016). The plant can also supply optimum nutrients for livestock productions inclusive of mineral needs, crude protein and essential amino acids (Bridgemohan et al., 2014; Sharif et al., 2016).

The purpose of this research was to investigate the dissolution of canine uroliths by *Moringha* root extracts using various aqueous and organic solvents. Because of the paucity of published work on *Moringha* effecting urolithdissolution, this preliminary study may add speculation pertaining to the treatment of uroliths in both human and animal medicine.

MATERIALS AND METHODS

Plant material

Moringa dry pod seeds were sourced from local Market vendors of Central Trinidad. Seedlings were germinated in the nursery, planted out at four weeks, and 4 m apart, on a high clayey soil at a rate of 50 seedlings per 600 per square metre. Average rainfalls at the time of harvesting of roots were 2.2 to 3.73 mm while average temperatures were between 27.7 and 28.1°C. *Moringa* roots were obtained from one year old plants which were grown without inputs of fertilizer or pesticides, but were irrigated manually.

Preparation of the extracts

Fresh roots (500 g) were macerated with a high speed blender, and the juice pressed out using a hydraulic press at 2500 psi and filtered (Experiment 1). The aqueous extract (AqE) was then diluted to concentrations of 40, 60, 80 and 100%, respectively. In Experiment 2, organic solvents ethanol, chloroform, and ether were used as extractants at the same concentrations.

Table 1. Effect of various aqueous dilutions aqueous of *M. oliefera* roots' dissolution rates of canine uroliths.

Concentration	Types of uroliths (% weigh loss)	
	Magnesium	Calcium
0	4.3	20
40	11.8	44
60	12.6	60
80	13.5	66
100	9.8	71

Table 2. Effect of different organic solvents on *M. oliefera* roots' dissolution rates of canine calcium uroliths.

Type of dissolution	Extractants (C)	Response	R ²
% weigh loss (% wl)	Ethanol	$y_{\%wl} = -10.2 + 0.641C$ (17.54) (0.266)	78.5
	Chloroform	$y_{\%wl} = 11.9 + 0.463C$ (6.86) (0.104)	86.7
	Ether	$y_{\%wl} = 108 - 0.93C$ (22.36) (0.405)	79.3
% reduction of surface area (% rsa)	Ethanol	$Y_{\%rsa} = 10.4 + 0.576C$ (14.53) (0.221)	79.3
	Chloroform	$Y_{\%rsa} = 21.1 + 0.55C$ (7.194) (0.109)	89.6
	Ether	$Y_{\%rsa} = 101 - 0.736C$ (22.36) (0.340)	78.9
Mean	10.4	52.2	
SD	3.67	20.66	

Anti-urolithiatic activity

Two types of canine uroliths (Figures 1 to 6), magnesium [MAP] and calcium [CaOx], were placed into the various extractants at respective concentrations. Eight (8) uroliths were used for each treatment and each test-tube placed in a shaker for 10 days after which the rates of dissolution were computed. Changes in stone-weight (g) and burden or size of concrement by surface area $\{SA = l \times W \times \pi \times 0.25\}$, and stone volume $\{SV = l \times W \times \pi \times 0.52\}$ were measured. The means and SE including a linear regression analysis was done on the rates of dissolution.

Anti-urolithiatic activity

The aqueous extract (AqE) was diluted to 40, 60, 80 and 100% concentrations (Table 1). In Experiment 2, ethanol, chloroform, and ether were used as the extractants at the same concentrations (Table 2). Changes in stone-weight (g) and burden or size of concrement by surface area $\{SA = l \times W \times \pi \times 0.25\}$, and stone volume were calculates as $\{SV = l \times W \times \pi \times 0.52\}$. Two types of uroliths used were magnesium (MAP) and calcium (CaOx). Eight (8) uroliths were used for each treatment and the test-tube placed in a shaken for 10 days after which the rates of dissolution were

measured. The mean and SE and the linear regression, wherever significant are reported.

RESULTS

In Experiment 1 (Table 1; Figures 4 and 5), the AqE did not affect the MAP uroliths (Table 2; Figure 4), but the rate of dissolution of the CaOx increased linearly (Equation 1):

$$y = 22.6 + 0.528 C. \\ [3.828] \quad [0.05825] \quad (1) \\ R^2 = 96.5\%$$

In the aqueous extract an average dissolution of calcium oxalate (CaO_x) was 77%. In Experiment 2 (Table 2), the increased concentration of ethanol and chloroform extracts increased linearly both the rates of dissolution by weight and the diminution of surface area, respectively. However, a converse response was observed with the ether extract as the rate of dissolution and diminution decreased linearly. The optimum rate of dissolution



Figure 3. Moringa roots.



Figure 4. Aqueous extraction of Moringa root.



Figure 5. Ethanol, chloroform, and ether extraction of Moringa roots.

observed for the ethanol and chloroform extracts was 70 % for weight, and 74% for surface area, respectively. The



Figure 6. Dissolution of canine uroliths in aqueous solution.

moringa root and the aqueous extractions are presented in Figures 3 and 4. The ethanol, chloroform, and ether extraction of Moringa roots and Dissolution of canine uroliths in the aqueous solution are exhibited in Figures 5 and 6, respectively.

DISCUSSION

Herbal supplements in veterinary botanical medicine is a rapidly growing and accepted intervention strategy for various clinical insults in animals (Romich, 2005). The oral use of aqueous extracts is considered a safe measure in treating various clinical conditions including urolithiasis in humans and animals.

The surgical intervention of clinical urolithiasis in sheep and goats is tube cystotomy for draining the overfilled bladder (Gazi et al., 2014). Perhaps a more innovative approach would be profusing the excised bladder with copious aqueous extracts of *Moringha* since this study suggest the latter can dissolve calcium oxalate uroliths (CaO_x) lodged within the bladder.

The dissolution rates of uroliths in organic solvents are probably associated with the presence of organic compounds unique to the *M. oliefera* plant species. These may include 4-(4'-O-acetyl- α -L-rhamnopyranosyloxy)benzyl isothiocy-anate, 4 (α Lrhamnopyranosyloxy)benzyl isothiocy-anate niazimicin pterygospermin benzyl isothiocyanate, and 4-(α -L-rhamnopyranosyloxy) benzyl glucosinolate as indicated by Sharif et al. (2016). Since we did not simulate in vitro conditions of uroliths formation with an in vivo experimental model, our findings cannot as yet be extrapolated as a preventative measure to urolithiasis. Further studies in this area may reveal its potential as an ethno-veterinary practice used in the prevention and correction of urolithiasis.

Conflict of Interests

The authors have not declared any conflict of interests.

ACKNOWLEDGMENTS

The authors acknowledges the assistance of Selena Khan, Research Technician, Dr. Gowrie Lalla, Veterinarian, The WRC Research Team, Robin, Jaikaran, Harpaul, and Ms. Abigal Le Gendre for their kind support in the conduct of this study.

REFERENCES

- Anwar F, Latif S, Ashraf M, Gilani AH (2007). *Moringa oleifera*: a food plant with multiple medicinal uses. *Phytother. Res.* 21(1):17-25.
- Bridgemohan P, Bridgemohan R, Mohamed M (2014). Chemical composition of a high protein animal supplement from *Moringa oleifera*. *Afr. J. Food Sci. Technol.* 5(5):125-128.
- Fazili IS, Masoodi M, Ahmad S, Jamal A, Khan JS, Abidin MZ (2010). Interactive effect of sulfur and nitrogen on growth and yield attributes of oilseed crops (*Brassica campestris* L. and *Eruca sativa* mill.) differing in yield potential. *J. Plant Nutr.* 33(8):1216-1228.
- Gazi MA, Makhdoomi DM, Parrah JD, Gania AM, Shiek GN, Mir SA (2014). Recent advances in surgical management of urolithiasis in sheep and goat. *Afr. J. Agric. Res.* 9(26):2055-2061.
- Grases F, Rafael M, Costa-Bauzá P, Costa-Bauzá A (1998). *In vitro* models for studying renal stone formation: a clear alternative ATLA. 26:481-503.
- Khare P, Mishra VK, Arun K, Bais N, Singh R (2014). Study on *in vitro* anti-lithiatic activity of *Phyllanthus niruri* linn. leaves by homogenous precipitation and turbidity method. *Int. J. Pharm. Pharm. Sci.* 6(4):124-127.
- Karadi RV, Gadge NB, Alagaivadi KR, Savadi RV (2006). Effect of *Moringa oleifera* root wood on ethylene glycol induced urolithiasis in rats. *J. Ethnopharmacol.* 105(1-2):306-311.
- Karadi RV, Palkar MB, Gaviraj EN, Gadge NB, Mannur VS, Alagawadi KR (2008). Antiuroliathatic Property of *Moringa olifeira* root bark. *Pharm. Biol.* 46:861-865.
- Lans C (2001). Creole remedies: Case studies of ethnoveterinary medicine in Trinidad and Tobago. ISBN 90 5808 4302.
- Maya S, Pramod C (2014). Evaluation of anti-nephrolithiatic activity of ethanolic leaf extract of *Morus Alba L.* in animal models. *Int. Res. J. Pharm.* 5(5).
- Makasana A, Ranpariya V, Desai D, Mendpara J, Parekh V (2014). Evaluation for the anti-urolithiatic activity of *Launaea procumbens* against ethylene glycol-induced renal calculi in rats. *Toxicol. Rep.* 1:46-52.
- Romich JA (2005). *Fundamentals of Pharmacology for Veterinary Technicians*. Clifton Park, NY : Delmar Cengage Learning 2ND Edition Cengage Learning, chapter 23, herbal therapeutics. P 612.
- Saha S, Verma RJ (2013). Inhibition of calcium oxalate crystallization *in vitro* by an extract of *Bergenia ciliate*. *Arab J. Urol.* 11:187-192.
- Sharif IH, Hasan M, Shakil M, Nazmuzzaman M, Banu NA, Islam R, Jamal MAHM (2016). A Review of phytochemical and pharmacological profile of *Moringa oleifera* Lam. *J. Life Sci. Biotechnol.* 3:75-87.

Full Length Research Paper

Major causes of organ condemnation and associated financial loss in cattle slaughtered at Hawassa Municipal Abattoir, Ethiopia

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Received 27 July, 2016; Accepted 15 September, 2016

Carcass and organ condemnations cause big economic losses in the cattle industry. A cross sectional study was conducted from October 2015 to May 2016 with the aim of identifying gross pathological changes that cause organ condemnation and to estimate the direct financial losses attributed to the condemned organs in cattle slaughtered at Hawassa municipal abattoir. Prior to slaughter, animals were subjected to routine ante-mortem examination. Post-mortem examination was used to identify the gross pathological changes. From the total of 384 slaughtered cattle examined postmortem, 171 (44.5%) liver, 137 (35.7%) lung, 36 (9.4%) spleen, 26 (6.8%) heart, 25 (6.5%) kidney and 9 (2.3%) tongue were totally condemned. Major causes of total condemnation of organs were fasciolosis, hydatidosis, pneumonia, emphysema, cirrhosis, calcification, nephritis, splenitis, edema, *Cysticercus bovis*, hemorrhage and abscess. There was statistically significant difference ($p < 0.05$) in condemnation of heart between animals with different body condition score. However, there was no statistically significant difference ($p > 0.05$) between animals' body condition score in condemnation of kidney, tongue, spleen, liver and lung. There was statistically significant difference ($p < 0.05$) between age in condemnation of lung and liver. The total financial loss calculated in this study, due to organ condemnation was 15,843.89 USD (342,228.00ETB) per annum. Therefore, the observation of such level of abnormalities and substantial financial loss with condemnation of affected organs warrants the veterinary institution of appropriate control measures.

Key words: Abattoir, cattle, financial loss, Hawassa, organ condemnation.

INTRODUCTION

Abattoirs played an important role in surveillance of various diseases of human and animals. Surveillance at the abattoir allows for all animals passing into human food chain to be examined for unusual signs, lesions or specific diseases (Alton et al., 2010). Monitoring and other conditions at slaughter has been recognized as one

way of assessing the disease status of herd; however, this source of information is not fully exploited worldwide (Mellau et al., 2010), especially in ascertaining the extent to which human is exposed to certain zoonotic diseases in addition to estimating the financial implications of organ condemnations (Jobre et al., 1996; Chhabra and

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Singla 2009).

Meat inspection is conducted in the abattoir for the purpose of screening animal products with abnormal pathological lesions that are unattractive and unsafe for human consumption. Meat inspection assists in detecting certain diseases of livestock and prevents the distribution of infected meat that could give rise to disease in animal and human being and to ensure competitiveness of products in the local market (Hinton and Green, 1993). Abattoir data can be a source of valuable information on the incidence and epidemiology of animal diseases. This can help to know to what extent the public is exposed to certain zoonotic diseases and estimate the financial losses incurred through condemnation of affected organs (Raji et al., 2010; Cadmus and Adesokan, 2009; Singla and Juyal, 2014).

The main causes of organ condemnation during post mortem inspection are diseases originated by parasites, bacteria and viruses. Flukes in liver and hydatid cyst in lung, liver and kidney are mainly involved (Mezegebu, 2003; Teka, 1997; Sirak, 1991). Parasites in the tropics are responsible for far greater loss to meat industry than any other diseases (Jobre et al., 1996). Similarly, like many other tropical countries in Africa, it is well known that parasitic diseases are the major factors responsible for low productivity in livestock in Ethiopia (Jobre et al., 1996; Abebe, 1995).

In Ethiopia, many studies have been undertaken to identify the major disease conditions encountered during antemortem and postmortem inspection and to determine the economic importance of organ and carcass condemnation (Jatenie et al., 2014). For instance, Fasciolosis, hydatid cyst, *C. bovis*, pneumonia, emphysema, hydronephrosis, cirrhosis, hepatitis, calcification and abscess were the major causes of organs condemnation in cattle slaughter at Adigrat municipal abattoir (Alembrihan and Haylegebriel, 2013). At Gonder ELFORA abattoir, the financial loss due to edible organ and carcass condemnation was estimated to be 1,268,579 USD (21,565,849 ETB) per annum. Fasciolosis and hydatidosis were the major causes for condemnation that lead to huge economic losses (Genet et al., 2012).

A report from Jimma showed that an average amount of 10,156.71 USD (172,664.09 ETB) was lost annually due to organ condemnation of cattle at the abattoir. Liver condemnation takes the higher proportion of all the losses accounting for 92.7% of all the losses at Jimma Municipal abattoir (Amene et al., 2012). Similar economic loss analysis by Fasil (2009) showed annual economic loss of 8826.41 USD (150,048.98 ETB) at Gondar Municipal abattoir. Another report in cattle slaughtered at Mekelle municipal abattoir revealed an estimated annual economic loss of 13110.86 USD (222,884.58 ETB) (Amene et al., 2012). Hence, it would be essential to have comprehensive information on occurrence of various diseases/causes and their economic loss to

establish appropriate strategy for prevention and controls. Causes of organ condemnation were not extensively studied in Hawassa Municipal Abattoir. Therefore, the objectives of the present study were: to identify the major causes of organ condemnation and to calculate the direct financial loss attributed to the condemned organs in cattle slaughtered at Hawassa Municipal Abattoir.

MATERIALS AND METHODS

Study area

The present study was conducted from October 2015 to May 2016 with the aims to identify major causes of organ condemnation and to calculate the direct financial loss due to condemnation in cattle slaughtered at Hawassa municipal abattoir. Hawassa city is located between 4° 27' and 8° 30'N latitude and 34° 25' and 39° 1' E longitude which is 275 km from south of Addis Ababa. The agro-ecology of the area is "wainadega" (semi-arid) having an altitude ranging from 1650 to 1700 m above sea level (masl). The average minimum and maximum temperature is 20.1 and 34°C, respectively (CSA, 2003).

Study population

The study animals were cattle slaughtered at Hawassa municipal abattoir for local consumption. These cattle were brought to the abattoir from different districts near Hawassa. These animals were kept under extensive production system in which the cattle were allowed to graze freely. The breeds of cattle were local and cross.

Sample size and sampling method

Sample size for the present study was determined by using the formula described by Thrusfield (2007). Since there was no previous data on the prevalence of organ condemnation in the study area, 50% prevalence was taken for sample size determination with 5% precision.

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

Where: N = required sample size, P_{exp} = expected prevalence, d = desired absolute precision.

Accordingly, the sample size was determined to be 384 heads of cattle. Systematic random sampling was used.

Study design

Cross-sectional study was carried out to estimate the cause of organ condemnation and to calculate the direct financial loss due to condemnation in cattle slaughtered at Hawassa municipal abattoir.

Study methodology

Ante mortem Inspection

Randomly selected animals were subjected to routine ante mortem inspection during which various risk factors such as body condition,

breed and age of animals were scored. The body condition score of animals was classified according to Nicholson and Butter (1986). Accordingly, animals were grouped into poor, medium and good body conditioned. Estimation of age was carried out by examination of teeth eruption and categorized into adult and old.

Post mortem inspection

The post mortem inspection was conducted based on the guidelines set on manual on meat inspection for developing countries (FAO, 1994). Accordingly, the liver, lung, heart, spleen, kidney and tongue were examined through visualization, palpation and systematic incision for any pathological lesion(s).

Assessment of direct financial loss

The total financial loss due to organ condemnation was computed based on the condemnation rate of each type of examined organs, average number of animals slaughtered in the abattoir per year from retrospective data of the abattoir, and condemnation rate of each organ. Average local market price of each organ was collected by questionnaire from the butcheries in Hawassa town, Ethiopia. The data obtained from Hawassa municipal abattoir indicated that the average annual slaughter rate of cattle at the abattoir was 19,000 heads of cattle/year. Consequently, the total direct financial loss was calculated by the following formula set by Ogunrinade and Ogunrinade (1980):

$$EL = \text{ésrk} \times \text{Coy} \times \text{Roz}$$

Where EL is estimated annual economic loss due to organ condemnation from domestic market; srk is annual cattle slaughter rate of the abattoir; Coy is average cost of each liver/lung/heart/kidney/tongue/spleen; Roz is condemnation rates of liver/lung/heart/kidney/tongue.

Data management and analysis

Collected data were recorded on specially prepared forms and entered into excel spreadsheet (Microsoft® office excel 2013) and analyzed by statistical software, SPSS version 20. Descriptive statistics was used to determine the condemnation rate of each organ, defined as proportion of organ condemned to the total number of that particular organ examined. Chi-square test was done to study association between the causes of condemnation and risk factors (breed, body condition score and age). The significance level was set at 0.05.

RESULTS

Out of 384 slaughtered cattle, 171 (44.5%) liver, 137 (35.7%) lung, 36 (9.4%) spleen, 26 (6.8%) heart, 25 (6.5%) kidney and 9 (2.3%) tongue were condemned due to gross abnormalities (Table 1) and found to be unfit for domestic markets and human consumption. The common macroscopic lesions encountered on liver were 21.1% Fasciolosis, 9.4% hydatidosis, 7.3% cirrhosis, 3.9% calcification, 1.5% abscess and 1.3% local necrosis. Lung was rejected due to pneumonia, hydatidosis, emphysema, abscess and hepatization with the rate of 10.2, 12.8, 10.2, 1.5 and 1.0%, respectively. Splenitis and splenomegaly were responsible for condemnation of 6.5

and 2.9% spleens, respectively. In the case of kidneys, 4.2, 1.5 and 0.8% were condemned due to nephritis, hemorrhage and infarction, respectively. Edema, pericarditis and hemorrhage caused the condemnation of heart at the rate of 2.9, 2.9 and 1.0%, respectively. 1.0 and 1.3% of the tongue examined were condemned due to *C. bovis* and abscess, respectively. Condemnation rate due to hydatidosis was higher in lung (12.8%) than liver (9.4%) (Table 1).

Rejection rate of all examined organs were higher in local than cross breed cattle. Liver was rejected at the rate of 39.8 (153/384) and 4.7% (18/384) in local and cross breed cattle, respectively. About 31.8 (122/384) and 3.9% (15/384) of lungs were condemned in local and cross breed cattle, respectively. The rejection rate of spleen, heart, kidney and tongue in local breed cattle were found to be 9.1 (35/384), 6.3 (24/384), 6.0 (23/384) and 1.8% (7/384), respectively. In cross breed cattle, the rejection rate of these organs was found to be 0.3 (1/384), 0.5 (2/384), 0.5 (2/384) and 0.5% (2/384), respectively. There was no statistically significant difference in rejection rate of organs between breed of animals ($p > 0.05$).

The rate of liver condemnation was higher in animals with medium body condition, 23.2% (89/384) followed by good, 14.3% (55/384) and poor body condition, 7.0% (27/384). Similarly, the rate of lung condemnation was higher in animals with medium body condition of 19.0% (73/384) followed by good, 12.8% (49/384) and poor body condition, 3.9% (15/384). The rejection rate of spleen, heart, tongue and kidney were higher in medium conditioned animals than good, and poor conditioned animals (Table 2). Except for heart ($X^2 = 7.318$; $df = 1$; $p = 0.007$), there was no statistically significant difference in rejection rate of organs among animals with different body condition score ($p > 0.05$).

The rejection rate of liver, lung spleen, heart, kidney and tongue were found to be higher in old than adult animals. In old animals, 31.2% (120/384) liver, 24.7% (95/384) lung, 5.2% (20/384) spleen, 5.5% (21/384) heart, 3.4% (13/384) kidney and 1.5% (6/384) tongue were condemned. In adult animals, the condemnation rate of 13.3 (51/384), 11.0 (42/384), 4.2 (16/384), 1.3 (5/384), 3.1 (12/384) and 0.8% (3/384) were recorded for liver, lung, spleen, heart, kidney and tongue, respectively. The rejection rate of liver and lung were significantly higher in old animals than in adult (liver $X^2 = 4.256$, $df = 1$, $p = 0.039$; Lung $X^2 = 6.899$, $df = 1$, $p = 0.009$).

The annual direct financial loss due to organ condemnation in cattle slaughtered at Hawassa municipal abattoir was estimated to be 15,843.89 USD (342,228.00ETB) (Table 3).

DISCUSSION

This study revealed that fasciolosis was the leading disease for condemnation of liver (21.1%). This finding is

Table 1. Causes and rate of organ condemnation in cattle slaughtered at Hawassa municipal abattoir during 2015/16.

Organ condemned	Causes of condemnation	Number (%*) condemned	Condemnation rate (%)
Liver	Calcification	15(8.8)	3.9
	Fasciolosis	81(47.4)	21.1
	Hydatidosis	36(21.0)	9.4
	Local necrosis	5(2.9)	1.3
	Abscess	6(3.5)	1.5
	Cirrhosis	28(16.4)	7.3
	Total	171(100.0)	44.5
Lung	Pneumonia	39(28.5)	10.2
	Hydatidosis	49(35.7)	12.8
	Emphysema	39(28.5)	10.2
	Abscess	6(4.4)	1.5
	Hepaticization	4(2.9)	1.0
	Total	137(100.0)	35.7
Spleen	Splenitis	25(69.4)	6.5
	Splenomegaly	11(30.6)	2.9
	Total	36(100.0)	9.4
Heart	Edema	11(42.3)	2.9
	Pericarditis	11(42.3)	2.9
	Petechial hemorrhage	4(15.4)	1.0
	Total	26(100.0)	6.8
Kidney	Nephritis	16(64.0)	4.2
	Hemorrhage	6(24.0)	1.5
	Infarction	3(12.0)	0.8
	Total	25(100.0)	6.5
Tongue	<i>C.bovis</i>	4(44.4)	1.0
	Abscess	5(56.6)	1.3
	Total	9(100.0)	2.3

*Percent per condemned organ.

comparable to that of Yifat et al. (2011) and Mungube et al. (2006) who reported the prevalence of 26% from Gonder and Kenya, respectively. Tadele and Worku (2007) from Jimma reported higher prevalence of 46.58%. In contrast, Alembrhan and Haylegebriel (2013) and Adigrat and Nebyou et al. (2014) from East Wollega found lower prevalence of 9.2 and 7.4%, respectively.

In this study, hydatidosis was the second leading pathological lesion responsible for the condemnation of lung and liver with the prevalence of 49 (12.8%) and 36 (9.4%), respectively. This finding was comparable with Nebyou et al. (2014) who reported prevalence of 26.55%. However, it was higher than the reports of Berihu and Toffik (2015) from Bako with the prevalence of 11.8%.

This result was lower than that of previous studies conducted by Asmerom and Berihun (2014) and Kebede et al. (2009) who reported the prevalence of 32 and 46.5%, from Shire and Debre zeyit, respectively.

In the present study, condemnation of spleen resulted to considerable economical loss caused by pathological conditions like splenitis (69.4%) and splenomegaly (30.6%). The current findings are in agreement with the studies reported by Fufa and Debele (2013) from Wolaita Sodo with the condemnation rate of 53%.

The main gross pathological changes that cause heart rejection in this study were edema, pericarditis and petechial hemorrhage which agree with the study done by Yifat et al. (2011) who reported that hydatidosis and

Table 2. Distribution of causes of condemnation among risk factors (breed, age and body condition) in cattle slaughtered at Hawassa municipal abattoir during 2015/16.

Organ condemned	Causes of condemnation	Risk factors						
		Breed		Age		Body condition		
		Local	Cross	Adult	Old	Poor	Medium	Good
Liver	Calcification	13(3.4%)	2(0.5%)	5(1.3%)	10(2.6%)	2(0.5%)	8(2.1%)	5(1.3%)
	Fasciolosis	74(19.3%)	7(1.8%)	26(6.8%)	55(14.3%)	11(2.9%)	47(12.2%)	23(6.0%)
	Hydatidosis	32(8.3%)	4(1.0%)	7(1.8%)	29(7.6%)	7(1.8%)	16(4.2%)	13(3.4%)
	Local necrosis	4(1.0%)	1(0.3%)	2(0.5%)	3(0.8%)	0(0.0%)	5(1.3%)	0(0.0%)
	Abscess	5(1.3%)	1(0.3%)	2(0.5%)	4(1.0%)	3(0.8%)	0(0.0%)	3(0.8%)
	Cirrhosis	25(6.5%)	3(0.8%)	9(2.3%)	19(4.9%)	4(1.0%)	13(3.4%)	11(2.9%)
	Total	153(39.8%)	18(4.7%)	51(13.3%)	120(31.2%)	27(7.0%)	89(23.2%)	55(14.3%)
Lung	Pneumonia	30(7.8%)	9(2.3%)	7(1.8%)	32(8.3%)	5(1.3%)	23(6.0%)	11(2.9%)
	Hydatidosis	44(11.5%)	5(1.3%)	13(3.4%)	36(9.4%)	7(1.8%)	23(6.0%)	19(4.9%)
	Emphysema	38(9.9%)	1(0.3%)	15(3.9%)	24(6.2%)	3(0.8%)	21(5.5%)	15(3.9%)
	Abscess	6(1.6%)	0(0.0%)	3(0.8%)	3(0.8%)	0(0.0%)	2(0.5%)	4(1.0%)
	Hepatization	4(1.0%)	0(0.0%)	4(1.0%)	0(0.0%)	0(0.0%)	4(1.0%)	0(0.0%)
	Total	122(31.8%)	15(3.9%)	42(11.0%)	95(24.7%)	15(3.9%)	73(19.0%)	49(12.8%)
Spleen	Splenitis	25(6.5%)	0(0.0%)	10(2.6%)	15(3.9%)	3(0.8%)	16(4.2%)	6(1.6%)
	Splenomegaly	10(2.6%)	1(0.3%)	6(1.6%)	5(1.3%)	1(0.3%)	7(1.8%)	3(0.8%)
	Total	35(9.1%)	1(0.3%)	16(4.2%)	20(5.2%)	4(1.0%)	23(6.0%)	9(2.3%)
Heart	Edema	9(2.3%)	2(0.5%)	3(0.8%)	8(2.1%)	5(1.3%)	6(1.6%)	0(0.0%)
	Pericarditis	11(2.9%)	0(0.0%)	0(0.0%)	11(2.9%)	3(0.8%)	4(1.0%)	4(1.0%)
	Hemorrhage	4(1.0%)	0(0.0)	2(0.5%)	2(0.5%)	0(0.0%)	1(0.3%)	3(0.8%)
	Total	24(6.3%)	2(0.5%)	5(1.3%)	21(5.5%)	8(2.1%)	11(2.9%)	7(1.8%)
Kidney	Nephritis	14(3.6%)	2(0.5%)	7(1.8%)	9(2.3%)	1(0.3%)	10(2.6%)	5(1.3%)
	Hemorrhage	6(1.6%)	0(0.0)	2(0.5%)	4(1.0%)	2(0.5%)	4(1.0%)	0(0.0%)
	Infarction	3(0.8%)	0(0.0)	3(0.8%)	0(0.0%)	1(0.3%)	0(0.0%)	2(0.5%)
	Total	23(6.0%)	2(0.5%)	12(3.1%)	13(3.4%)	4(1.0%)	14(3.6%)	7(1.8%)
Tongue	<i>C.bovis</i>	3(0.8%)	1(0.3%)	2(0.5%)	2(0.5%)	1(0.3%)	3(0.8%)	0(0.0%)
	Abscess	4(1.0%)	1(0.3%)	1(0.3%)	4(1.0%)	0(0.0%)	5(1.3%)	0(0.0%)
	Total	7(1.8%)	2(0.5%)	3(0.8%)	6(1.5%)	1(0.3%)	8(2.0%)	0(0.0%)

pericarditis were the main causes of heart condemnation. However, Alembrhan and Haylegebriel (2013) reported that Hydatidosis and *C. bovis* were the main causes of heart rejection.

Nephritis, hemorrhage and infraction were the major causes of kidney rejection in this study. The results of this finding were in agreement with the study done by Yesihak et al. (2015). However, Jatenie et al. (2014) reported that *C. bovis* and hydatidosis were the main cause of kidney rejection. The main cause of tongue condemnation was *C. bovis* and abscess which is in agreement with other study reported by Lati et al. (2015) from Wollega. Organ condemnation rates did not show statistically significant difference ($P > 0.05$) in breed and

there was no statically significant difference ($p > 0.05$) between BCS and condemnation of liver, kidney, tongue, spleen and lung but it was statically significant for heart ($p < 0.05$). Condemnation rate of lung and liver showed statistically significant difference between age groups of animals ($p < 0.05$) but not for spleen, heart and tongue in the age groups of animals. Variation in the proportion of organs condemned due to gross pathological changes may be due to differences in agro-ecological condition of the animal environment that could be favorable to the causative agent, livestock management system and improper disposal of condemned organs. The total financial loss calculated in this study due to organ condemnation was 15,843.89 USD (342,228.00ETB) per

Table 3. Annual financial loss due to condemnation of organ (average annual slaughtered animal n=19,000).

Condemned organs	Rejection rate (%)	Av.unit price(ETB)*	Annual loss (ETB)*
Liver	44.5	30	253,650.00
Lung	35.7	6	40,698.00
Heart	6.8	15	19,380.00
Kidney	6.5	7	8,645.00
Tongue	2.3	25	10,925.00
Spleen	9.4	5	8,930.00
Total annual loss			342,228.00

During the study period 1USD=21.60ETB.

year which have extreme difference with the report done by Nebyou et al. (2014) from Nekemte, Ethiopia with loss of 5,435.97 USD (106,536.9 ETB) per year. The difference in the financial loss estimated in various abattoirs may be due to the variation in the prevalence of disease, mean annual number of cattle slaughtered in different abattoir which was higher in Hawassa municipal abattoir, and also, the variation in the retail market price of the organ.

CONCLUSION AND RECOMMENDATIONS

Organ condemnations cause big economic losses in the cattle industry. In this study, the rates of condemnation of organs were higher in liver followed by lung, spleen, heart, kidney and tongue. Major causes of total condemnation of organs were fasciolosis, hydatidosis, pneumonia, emphysema, cirrhosis, calcification, nephritis, splenitis, edema, *C. bovis*, hemorrhage and abscess. The total financial loss calculated in this study, due to organ condemnation was 15,843.89 USD (342,228.00ETB) per annum. Thus, proper meat inspections are essential to remove gross abnormalities from meat and its products in order to prevent the distribution of contaminated meat to the public.

Based on the findings of this study, the following recommendations were forwarded:

1. Promoting construction of abattoir with their appropriate disposal pits and immediate and proper disposal of condemned organ should be made.
2. Meat inspectors and abattoir workers should be well trained on handling condemned carcasses and organs.
3. Public awareness should be given to avoid eating of raw meat/organs hence for effective disease control.

Conflict of Interests

The authors have not declared any conflict of interests.

REFERENCES

- Abebe G (1995). Current status of veterinary education and health research in Ethiopia in Veterinary Medicine impact on health and nutrition in Africa. Proceeding of an international conference, Addis Ababa. pp. 133-138.
- Alembrhan A, Haylegebriel T (2013). Major causes of organ condemnation and economic loss in cattle slaughtered at Adigrat municipal abattoir, northern Ethiopia. *Vet. World.* 6:734-738.
- Alton GD, Lpeah D, Bateman KJ, McNab WB, Berk O (2010). Factors associated with whole condemnation rates in provincially inspected abattoir in Ontario: Implication for food animal syndromic surveillance. *BMC Vet. Res.* pp. 6:42.
- Amene F, Eskindir L, Dawit T (2012). Cause Rate and Economic Implication of Organ Condemnation of Cattle Slaughtered at Jimma Municipal Abattoir, Southwestern Ethiopia. *Glob. Vet.* 9:396-400.
- Berihu H, Toffik K (2015). Study on Prevalence Economic Significance of Bovine Hydatidosis in Bako Muncipal Abattoir, West Shoa zone, Oromiya Regional State, Ethiopia. *Glob. J. Anim. Sci. Res.* 3:109-118.
- Cadmus SIB, Adesokan HK (2009). Causes and implications of bovine organs/offal condemnations in some abattoirs in Western Nigeria. *Trop. Anim. Health Prod.* 4:1455-1463.
- Central Statistical Authority (CSA) (2003). Livestock population of Ethiopia. Central Statistical Authority.
- Chhabra MB, Singla LD (2009). Food-borne parasitic zoonoses in India: Review of recent reports of human infections. *J. Vet. Parasitol.* 23(2):103-110.
- Fasil B (2009). Major causes of organ condemnation in cattle slaughtered at Gondar ELFORA abattoir. Faculty of Veterinary Medicine, Jimma University, Jimma, Ethiopia, DVM Thesis.
- Fufa A, Debele H (2013). Major Causes of Organ Condemnation for Cattle and its Financial Impact at Wolaita Soddo Municipality Abattoir, Southern Ethiopia. *Glob. Vet.* 11:730-734.
- Food and Agriculture Organization(FAO)(1994). Manual of meat inspection for developing countries.
- Genet M, Tadesse G, Basaznew B, Mersha C. (2012). Pathological Conditions Causing Organ and Carcass Condemnation and Their Financial Losses in Cattle Slaughtered in Gondar, Northwest Ethiopia. *Afr. J. Basic Appl. Sci.* 4:200-208.
- Hinton M, Green L (1993). Meat inspection which goes though university of Bristol, Langford, UK. *Vet. J.* 152:91-92.
- Jatenie J, Mahendra P, Rahman T (2014). Investigation into major causes of organs condemnation in bovine slaughtered at Adama municipal abattoir and their economic importance. *Haryana. Vet.* 53:139-143.
- Jobre Y, Lobago F, Tiruneh R, Abebe G, Dorchie PH (1996). Hydatidosis in three selected regions of Ethiopia: An assessment trial on the prevalence, economic and public health importance. *Rev. de med. Vet.* 147:797-804.
- Kebede N, Mitiku A, Tilahun G (2009). Hydatidosis of slaughtered animals in BahirDar abattoir, northwestern Ethiopia. *Trop. Anim. Health Prod.* 41:43-50.

- Lati E, Biresaw S, Berhanu S, Eyob H (2015). Causes of organ condemnation, its public health and financial significance in Nekemte municipal abattoir, Wollega, Western Ethiopia. *J. Vet. Med. Anim. Health*. 7:205-214.
- Mellau LSB, Longa HE, Karimuribu ED (2010). A Slaughter house survey of liver lesion in slaughter cattle, sheep and goats at Arusha. *Tanzan. Vet. J.* 3:179-188.
- Mezegebu Y (2003). Major cause of organ condemnation in ruminants slaughtered at Gonder Abattoir, North Western Ethiopia. DVM thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debre-Zeit, Ethiopia.
- Mungube EO, Bauni SM, Tenhagen BA, Wamae LW, Nginyi JM and Mugambi JM (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.
- Nebyou M, Debela A, Solomon K, Tesema T, Fanta D, Alemayehu R (2014). Major Causes of Organs and Carcass Condemnation in Cattle Slaughtered at Nekemte Municipality Abattoir, East Wollega, Ethiop. *Glob. Veter.* 13:278-284
- Nicholson MJ, Butter MH (1986). A guideline to condition scoring of Zebu cattle. International Livestock Center for Africa, Addis Ababa, Ethiopia.
- Ogunrinade A, Ogunrinade BI (1980). Economic importance of bovine fasciolosis in Nigeria. *Trop. Anim. Health Prod.* 12:155-160.
- Raji MA, Salami SO, Ameh JA (2010). Pathological condition and lesions observed in slaughtered cattle at Zaria abattoir. *J. Clin. Pathol. Forensic Med.* 1:9-12.
- Singla LD, Juyal PD (2014). Sarcocystosis. In: *Zoonosis: Parasitic and Mycotic Diseases*, Garg SR (Ed), Daya Publishing House, New Delhi, pp 235-250.
- Sirak A (1991). Cause of organ condemnation in Bahir-Dar abattoir. DVM thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debre-Zeit, Ethiopia.
- Tadele T, Worku T (2007). The Prevalence and Economic Significance of Bovine Fasciolosis at Jimma, Abattoir, Ethiopia. *Int. J. Vet. Med.* pp. 3:15.
- Teka G (1997). Meat hygiene in: Food hygiene principles and methods of food born disease control with special reference to Ethiopia. pp. 99-113.
- Thrusfield M (2007). *Veterinary Epidemiology*. (3rd edition.). Blackwell Science.
- Yesihak Y, Mummed E, Webb C (2015). Causes of Beef Carcass and Organ Condemnations in Ethiopia. *J. Anim. Vet. Adv.* 10:147-160.
- Yifat D, Gedefaw D, Desie S (2011). Major Causes of Organ Condemnation and Financial Significance of Cattle Slaughtered at Gondar ELFORA Abattoir, Northern Ethiopia. *Glob. Vet.* 7:487-490.

A veterinarian wearing blue scrubs and a white surgical mask is examining a small brown dog's mouth. The dog is lying down, and the veterinarian is using a stethoscope. The background is a solid blue color.

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