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Evaluation of Risk Factors Associated with Coccidiosis in Broiler Farms of Selected Towns of Ethiopia

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Abstract: This study aimed to assess the prevalence and management issues associated with coccidiosis in broiler. Data were collected from 100 broiler farms located in four selected towns in Central Ethiopia from August 2011 to April 2012. Three chickens per flock; and fecal samples from 88 and 12 small- and large-scale broiler farms were collected respectively. The overall prevalence rate of coccidiosis was 60%. The occurrence of subclinical form of infection (80%) was relatively higher. The incidence of coccidiosis was significantly higher in the small scale broiler farms ($P<0.05$), chickens aged 4-6 wks ($P<0.01$) and farms with large flock size within the small scale broiler farms ($P<0.01$). Chickens were submitted for post-mortem and parasitological examinations. Six *Eimeria* spp. were identified: *E. acervulina*, *E. brunetti*, *E. maxima*, *E. mitis, E. necatrix* and *E. tenella*. Mixed infection was detected in 63.3% of the farms. *Eimeria tenella* was the most prevalent species identified (28.3%). Prevalence did not vary by flock size in the large scale broiler farms. A seasonal difference in the incidence of coccidiosis was not observed. The association between the incidences of coccidiosis and the use of anticoccidial drugs was not significant ($P>0.05$). It was observed that there are inter-farm differences in the prevalence of coccidiosis. Disease control measures and management practices in the study farms were generally poor. Regular check up for coccidian infection will help in detecting subclinical coccidiosis and will prevent economic losses. Proper control measures must be taken in the application of strict bio-security measures and anti-coccidian programme.

Key words: Broiler · Coccidiosis · *Eimeria* · Risk Factors Prevalence

INTRODUCTION

According to the Central Statistical Authority of Ethiopia [1], 97.79% of the total poultry population comprises indigenous birds while 2.21% are exotic breeds. Based on the level of bio-security, FAO classifies Ethiopian poultry production systems into three: large commercial poultry production with "moderate to high biosecurity", small commercial poultry production with "low to minimal" biosecurity and village or backyard production with "minimal biosecurity [2].

There are more than 20 privately owned large scale commercial poultry farms; all located in and around Addis Ababa, mainly in and around Debre Zeit town [3]. Contrary to the backyard farming system, large and small-scale intensive farms are dependent on imported exotic breeds requiring high levels of feed, housing and sanitary inputs [4]. Relatively large scale intensive poultry production system is also practiced by government poultry multiplication and distribution centers located in various regions of the country [2, 5]. Small-scale intensive systems are also emerging in urban and peri-urban areas of the country, with a small number of exotic breeds of chicken ranging from 50 to 1000 located in strategic areas close to market destinations.

Although traditional production methods dominate the market for birds, eggs and meat during the past 15-20 years, there has been a gradual rise in commercial small-and medium-scale flock production system in Ethiopia [5]. These systems, however, are adversely affected by a variety of constraints. Poultry diseases and management problems continue to play the major role in hindering its development [6, 7].

Coccidiosis is recognized as the major parasitic disease of poultry and is caused by the apicomplexan protozoan *Eimeria*. The disease seriously impairs the

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growth and feed utilization of infected birds, resulting in loss of productivity [8]. In Ethiopia, coccidiosis is endemic in all parts of the country and affects mainly young growing birds [6].

Factors contributing to outbreaks of clinical coccidiosis include litter moisture content exceeding 30% due to ingress of rain or leaking waterers, suboptimal inclusion of anticoccidials or incomplete distribution (Poor mixing) of feed and environmental and husbandry stresses such as overstocking, inadequate ventilation and inoperative feeding systems [9]. Immunosuppressive diseases such as infectious bursal disease, chicken infectious anemia and Marek's disease are the major infectious diseases that increase susceptibility to viral, bacterial and parasitic diseases and interfere with acquired vaccine immunity [10]. Due to the growing interest in intensive poultry production, it is important to continually evaluate the prevalence and management issues associated with common poultry diseases such as coccidiosis. This study was conducted to assess the prevalence and management issues associated with poultry coccidiosis in broiler farms located in four selected towns located in central Ethiopia.

MATERIALS AND METHODS

Study Site: Data for this experiment were collected from small- and large-scale broiler farms located in Debre Zeit, Dukem, Mojo and Nazareth towns all located in the Central Ethiopia.

Study Animals: Data were collected from August 2011 to April 2012. A total of 88 small- and 12 large-scale broiler farms (Chicken flocks) were randomly selected. Most of the farms were small-scale broiler farms that had only one or two flocks. The flock size ranged from 100 to 2,500 and 3,000 to 6,000 birds per house for small- and large-scale broiler farms, respectively. All broiler chickens were housed in an intensive deep-litter system. Water is provided through an automatic waterer in large and through plastic waterer in small scale commercial broiler farms. All the study flocks were vaccinated against Newcastle and Infectious Bursal Diseases, while anticoccidial vaccination was not applicable. During the trial period, the chickens were handled following institutional and international ethical principles on the use of birds in experimental research.

Study Design: The study design consists of cross sectional epidemiological study to determine the prevalence of coccidiosis at the flock level and to identify the *Eimeria* species circulating within the study farms.

Questionnaire Survey: Information from the farmers and managers in the selected farms were collected using semi-structured questionnaire. Farm records and direct observation on the hygienic practices and bio-security in each farm were also noted. Data such as housing management including ventilation, hygiene and sanitation, flock size, the use of anticoccidial drug, age of infected chickens, chicken management, disease diagnosis, disease occurrence other than coccidiosis, feed and water supply, disease and disposal mechanism and season of disease occurrence were included in the questionnaire format.

Parasitological Techniques

Sampling: Three chickens per flock for post-mortem examination and pooled fecal samples were collected from 88 and 12 small- and large-scale broiler farm houses.

Identification of *Eimeria* Species: The identification of *Eimeria* species was performed based on a combination of characteristics, including examination of the shape and size of oocysts, site of development in the intestinal tract, characteristic macroscopic lesions and size of meronts in mucosal smears [11-13]. Three chickens from each house were euthanized by cervical dislocation and were subjected to routine post-mortem examination. The upper, medium, lower intestinal and cecal mucosa were examined for gross pathological changes according to the method described by Conway and McKenzie [8]. The location of the lesion in each intestinal tract was recorded. In addition, the intestinal and cecal scrapings were prepared for microscopic examination, for the detection of schizonts and oocysts. The intestinal and cecal contents from *Eimeria* oocyst positive samples were transferred into a sterile plastic tube and the *Eimeria* oocysts were isolated using the simple floatation technique [14].

Fecal Egg Count: Fecal dropping for litter oocyst counts was collected from several representative areas of each chicken house. The samples were collected from the top layers of material as a “Handful’’ of litter and were mixed together and 1 g of material was weighed. These materials were soaked in 2.5% potassium dichromate overnight.

The next day, the solution was poured through a small-grade sieve into a beaker. The solid materials were washed with water through the sieve into the same beaker. The remaining solid materials were discarded and the fluid sample was centrifuged to sediment the oocysts. The supernatant was discarded and the pellet was re-suspended in the saturated salt solution (NaCl) for the detection and counting of Eimerian oocysts [8]. The number of oocyst per gram (OPG) of feces was calculated using the simple McMaster saturated salt flotation technique described by Permin and Hansen [14].

Statistical Analysis: Prevalence data was analyzed using Statistical Analysis System (SAS) software [15] and Chi-square procedures and mean differences were declared at $P<0.05$. The Fisher's exact test was used to evaluate the presence of association between the prevalence of coccidiosis and risk factors (Number of broilers per flock, administration of anticoccidial drug, age of affected chicken in weeks, chicken management, disease diagnosis, type of farm and season).

RESULTS

The prevalence data for coccidiosis is presented in Table 1. The overall prevalence of the disease was 60% while the subclinical form of coccidian infection was 80%. Analysis of variance for the effect of factors associated with prevalence of coccidiosis is presented in Table 2. The result indicated that the occurrence of coccidian infection in the small-scale broiler farms was significantly higher than that of the large-scale farms ($P<0.05$). The incidence of coccidiosis in flocks with chickens aged 4-6 wk was significantly higher than those aged 1-3 weeks ($P<0.01$). Flock size significantly affected the incidence of coccidiosis ($P<0.01$). Accordingly, the incidence of coccidiosis in the small-scale broiler farms which owned 501-1000 chickens was higher than the other two groups (Table 2). Out of the examined broiler farms, 61.19% of the producers had no awareness about coccidiosis. Supervisor type, prophylactics treatment and season did not affect the incidence of coccidiosis ($P>0.05$).

The total oocysts count per gram of feces from the litter ranged from 1-500, 501-1,000 and 1,001-5,000 in the 81.67, 11.67and 6.67 % of infected flocks, respectively (Table 3). Information on prevalence of single and mixed infections of *Eimeria* species in broiler farms is presented in Table 4. Most of the study farms were located in the residential areas. Hygiene and biosecurity measures and management practices in these farms were generally poor. *Eimeria* species identified were *E. acervulina*, *E. brunetti, E. maxima, E. mitis, E. necatrix* and *E. tenella*. The infection rate of *Eimeria* spp. identified in these farms was 5, 3.33 and 28.33% for *E. acervulina*, *E. maxima* and *E. tenella*, respectively. Mixed infection with various *Eimeria* species was highly prevalent 63.3%.

Proportion of infected flocks in broiler farms as affected by various categories of risk factors is presented in Table 5. Although coccidiosis is not the only cause of mortality in the study farms, there was a difference in the level of mortality between coccidiosis infected broiler farms. The highest mortality rate was observed in the younger chicken flocks; however, this was absent in the older chicken flocks. The highest level of mortality was also demonstrated in farms with highest number of oocyst count.

DISCUSSION

The higher prevalence of subclinical form of coccidia infection in the present study was largely associated with multiple species. This is similar to the findings of Taylor *et al*. [12] who reported that the disease tends to be chronic and may be associated with several species of *Eimeria*. Mortality may not be heavy but morbidity may retard growth significantly. The higher occurrence of coccidian infection in the present study might have been due to the lack of disease control measures and poor management practices under the small scale broiler farms; such as absence of anticoccidial agents in feed and treatment to apparently diseased chickens and lack of awareness. Most of the time treatment is given whenever the clinical sign appears. The poor hygienic and bio-security measures and husbandry practices observed in the present study farms are in line with reports of Mersha *et al*. [7] in which the absence of disposal of litters, wetting of litters from leaking pipes and drinking troughs and the absence of all-in all-out system were reported to be possible risk factors disposing chickens to the occurrence of various diseases including coccidiosis in broiler farms in Central Ethiopia.

The higher occurrence of coccidiosis (63.64%) in the small-scale broiler farms in the present work was higher than that was reported by Mersha *et al*. [7] who indicated 43.3% prevalence rate in the small-scale broiler farms, but the 33.3% incidence rate reported in the large-scale broiler farms is in the present study was lower than that 50% reported in the large-scale broiler farms of Central Ethiopia [7].

Table 1: Prevalence of coccidiosis in 100 broiler farms of central Ethiopia

Flocks	No. flocks	No. positive flocks	Overall prevalence (%)	Clinical infection (%)	Sub clinical infection (%)
Large scale	12	4	33.3	25	75
Small scale	88	56	63.64	19.6	80.36
Total	100	60	60	20	80

Table 2: Relative importance of different risk factors associated with prevalence of coccidiosis in broiler farms

Risk factors	Risk factors in category	Number of flocks	Number of positive flocks	% of positive flocks	P value
Farm type	Large scale	12	4	33.33	(P<0.05)
	Small scale	88	56	63.64	
Age (week)	1-3	34	8	23.53	(P<0.01)
	4-6	63	49	77.78	
	> 6	3	3	100	
Flock size	100-500	43	15	34.88	(P<0.01)
	501-1000	36	33	91.67	
	1001-5945	21	12	57.14	
Awareness	No	67	41	61.19	NS
	Yes	33	19	57.58	
Supervisor	Farm owner	70	39	55.71	NS
	Health assistance	30	21	70.00	
Prophylactic treatment	No	50	33	66.00	NS
	Yes	50	27	54.00	
Season	Dry	32	20	62.50	NS
	Rainy	68	40	58.82	

NS = Not significant

Table 3: Proportion of infected flocks across different ranges of oocyst count in broiler farms as affected by flock size

		Range of oocyst count (× 100)		
Flocks	No. of infected flocks	1-500	501-1000	1001-5000
Large scale	4	75.00 %	25.00 %	0.0 %
Small scale	56	82.14 %	10.71 %	7.14 %
Total	60	81.67 %	11.67 %	6.67 %

Table 4: Prevalence of single and mixed infections of Eimeria species

Farm type	No. of infected flocks	*E. acervulina*	*E. maxima*	*E. tenella*	Mixed infection[1]
		(%)	(%)	(%)	(%)
Large scale	4	0.00	0.00	0.00	100
Small scale	56	5.36	3.57	30.36	60.7
Total	60	5.00	3.33	28.33	63.3

[1] Mixed infection = (*Eimeria acervulina*, *Eimeria brunetti, Eimeria maxima, Eimeria mitis, Eimeria necatrix* and *Eimeria tenella*)

Table 5: Proportion of infected flocks across different ranges of mortality in broiler farms as affected by various categories of risk factors

			Level of mortality		
Risk factors	Category of risk factors	Number of positive flocks	0.5-6%	6.2-9%	9.2-22%
Farm type	Large scale	4	25	0	75
	Small scale	56	57	27	16
Age (week)	1-3	8	50	13	38
	4-6	49	55	27	18
	>6	3	67	33	0
Flock size	100-500	15	40	27	33
	501-1000	33	73	15	12
	1001-5945	12	25	50	25
OPG	1-500	49	57	22	20
	501-1000	7	43	43	14
	1001-5000	4	50	25	25

OPG = Oocysts per gram

The significant inter-farm differences in the prevalence of coccidiosis were similar to those reported by Lobago *et al*. [6] and Nematollahi *et al*. [16], who found higher prevalence of coccidiosis in chickens aged 5-6 wks. Coccidiosis is largely a disease of young animals because immunity quickly develops after exposure and gives protection against later disease outbreak. Unfortunately, there is no stimulation of cross-protective immunity between species of *Eimeria*. Thus, several outbreaks of coccidiosis are possible in the same flock, with different species involved in each [13].

The higher prevalence of coccidiosis in farms with large flocks (91.6%) in the present work is in line with those reported by Razmi *et al*. [17] who confirmed the rising prevalence of coccidiosis with increasing flock size. The higher prevalence rate recorded in the small-scale flocks and the lower in the large-scale flocks could be associated with differences of husbandry practices employed under in the small- and large-scale broiler farms.

The location of farms, use of feeds of low and unknown quality and poor management practices used by small scale broiler farms might have been the major factors for the higher occurrence of incidence of coccidiosis. Wossene [4] and Ayele *et al*. [18] have also reported that the bio-security status in many of the intensive poultry farms in Ethiopia is extremely poor and the management and health care practices are generally inadequate. The quality of mixed feeds used by poultry producers was also reported to be poor [3] and most formulations available do not have vitamin/mineral premixes. Ingredients and processed feeds vary in nutritive value and there is no regular quality control mechanism in the country [2].

Some producers interviewed in the present study complained about the ineffectiveness of the anticoccidial drugs and this might be associated with development of drug resistant strain of *Eimeria*. In the same token, anticoccidial drugs added to feed could serve as a good preventive measure and can be well adapted to large-scale use. But given the prolonged use of these drugs in the production system where the resent study is conducted, the occurrence of coccidial resistance is anticipated and such has been reported by different authors [11, 19-22].

In addition, a drug may be efficacious against one or several of *Eimeria* species; very few drugs are equally efficacious against all. Some drugs kill the parasite but others only arrest the development of them. The arrested parasites can develop and affect their chickens whenever treatment is discontinued. McDougald and Fitz-Coy [13] described that when coccidiostatic medication is withdrawn, arrested parasites may continue to develop and contaminate the environment with oocysts. In such cases, a relapse of coccidiosis is possible. Outbreaks of coccidiosis may also occur in birds on medicated feed due to the level of coccidiostat used is low or conditions in the house have changed to allow a massive sporulation of oocysts, which on ingestion, the level of drug can no longer control [12]. No seasonal difference in the incidence of coccidiosis was observed. This could have been due to the short period of time used for sampling the farms.

The current study showed that six pathogenic *Eimeria* species known to parasitize chickens were occurred as single or multiple infections in broiler farms of central Ethiopia. This agrees with the findings of other authors in the literature [6, 7, 23-25] who reported multiple species of *Eimeria* on exotic chickens reared in deep litter from different places of Ethiopia. The occurrences of mixed infections were very high, which could be related to the low level husbandry practice and development of drug resistant strain of *Eimeria* to variable compounds.

In conclusion, the present study indicated that occurrence of coccidia infection in the study farms was significantly higher in the small scale broiler farms, in flocks with 4-6 wks age chickens and farms with large flock. No association between incidences of coccidiosis and the use of anticoccidial drugs was revealed. *Eimeria* species identified in this study were *E. acervulina*, *E. brunetti, E. maxima, E. mitis, E. necatrix* and *E. tenella*. Six pathogenic *Eimeria* species known to parasitize chickens were occurred as single or multiple infections in broiler farms. *Eimeria tenella* was the predominant case in the present study areas. The occurrence of subclinical form of infection was higher and mostly associated with various *Eimeria* species. This may play a great role in the retardation of growth as well as the economy of commercial poultry farming in the area.

It is recommended that regular check up for coccidian infection or identification of *Eimeria* species will help in detecting subclinical coccidiosis and will prevent economic losses. Good ventilation will reduce the humidity in the house and help to keep litter dry. The use of appropriate anticoccidial drugs as a prophylactic treatment in poultry feeds is highly recommended. As an alternative to coccidial resistance the use of drug rotation, with constant monitoring of the oocysts in the feces and in the litter, or shuttle programme is important. It is recommended that drugs are switched between batches of broilers; drugs have a minimum period (5 to 7 days) or which they must be withdrawn before the bird's can be

slaughtered for human consumption. Training should be given to producers concerning chicken coccidiosis and its economic importance. Preferably clean litter should always be provided between batches of birds. If this is not possible, the litter should be heaped and left for 24 hours after it has reached a temperature of 50°C; it should then be forked over again and the process repeated to ensure that all the oocysts in the litter have been destroyed. Litter should always be kept dry and special attention given to litter near water fonts or feeding troughs. Proper control measures must be taken in the application of strict bio-security measures and anti-coccidial programme. Poultry houses should be disinfected in the intervals between depopulation and restocking.

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