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Original Article

Prevalence and Aetiology of Poultry Coccidiosis and Associated Risk Factors in White Leghorn Grower Chickens at Kombolcha Poultry Farm, Ethiopia

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ABSTRACT

A study was conducted from October 2009 and March 2010 with the objective of determining the prevalence of poultry coccidiosis and identifying the species of Eimeria at Kombolcha poultry farm. A total of 638 dead White leghorn chickens of age 1 to 60 days were examined on post mortem, mucosal scraping examination, examination of gross and histopathological changes, and identification of Eimeria species. Prevalence rate of 22.3% (142/638) was assessed. A statistically significant difference $p< 0.05$ ($\chi^2 = 261.995$, $p = 0.000$) was noted among the studied age groups with maximum prevalence at 41-50 days of age. Five Eimeriaspecies were identified, namely: *E. tenella*(37.86 %), *E. brunette* (29.22 %), *E. necatrix*(12.35 %), *E. acervulina*(15.22 %), and *E. maxima* (5.35 %)which were identified for the first time in the farm. In conclusion, coccidiosis remained still a major problem in the farm by changing its mode of occurrence from time to time as to the variations of the management system. Further strategies needs to be implemented to reduce the loss due to coccidiosis.

Key words: Coccidiosis, Eimeria, Ethiopia, Kombolcha, Poultry, Prevalence

INTRODUCTION

Poultry coccidiosis, caused by several distinct species of *Eimeria*, remains the most economically significant parasitic infection of the poultry industry, worldwide (McDougald, 2003). The disease is endemic in most of the tropical and subtropical regions where ecological and management conditions favour an all-year round development and propagation of the causal agent (Obasi et al., 2006).

Substantial work on coccidiosis based on experimental infections and drug and vaccine trials has been presented over many years. However, reports on infection prevalence, infection levels and frequencies of the different Eimeria species in commercial poultry productions are few and sporadic. Often the reports are not comparable due to the difference in management and production systems, sample materials, sampling periods, sampling methods and prophylactic measures applied. More knowledge of the etiology and population dynamics of mixed coccidial infections in commercial poultry production is therefore needed (Haug et al., 2008). Moreover, with the increasing interest in poultry production evidenced by the proliferation of poultry farms, it is pertinent to continually evaluate the prevalence, frequencies of the different Eimeria species and management issues associated with common poultry diseases such as coccidiosis in any given zone (Etuk et al., 2004).

In Ethiopia despite the immense research works done by several outstanding researchers in the area of poultry coccidiosis in different parts of the country (Ashenafi, 2000; Methusela, 2001; Methusela et al., 2002; Lobago et al. 2003; Methusela et al. 2004; Gari et al., 2008), the disease is still continued being a major problem demanding much research and investigation. Regarding the disease poultry coccidiosis in Amhara region in Kombolcha Poultry Breeding and Multiplication Centre (KPBMC), information is scant except Lobago et al. (2005) who have done his research half decades ago on Rhode Island Red (RIR) grower chickens of 1- 60 days age. However, no research has been done in White Leghorn grower chickens of 1- 60 days age in the study site, yet. Moreover, the relatively high prevalence of coccidiosis (38.34 %) reported by Lobago et al. (2005) suggests the prime importance of this disease in Kombolcha poultry farm. Therefore, the objectives of this study were to evaluate the prevalence of poultry coccidiosis in White Leghorn grower chickens from 1- 60 days age, to identify the prevalent species of Eimeria, and to assess some of the predisposing factors associated with the occurrence of poultry coccidiosis in the study site.

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MATERIALS AND METHODS

Study area

The study was conducted in Kombolcha Poultry Breeding and Multiplication Centre (KPBMC), Kombolcha, South Wollo, North Eastern Ethiopia of the Amhara National Regional State. It is located 380 km north of Addis Ababa and 500 km west of BahirDar at an altitude of 1864 meter above sea level and the centre is situated at 11^{o} 07' N latitude and 39^{0} 44' E longitudes. The area has experienced a bimodal rain fall distribution with a three year an annual average of 1038 mm, annual mean temperature of $18^{o}C$ and relative humidity from 23.9% to 79% (CSA 2008).

Study animals and population

The study was performed in layer type White Leghorn (WLH) breeds of grower chickens age from 1-60 days, which were kept for an extension service program. A total of 19,212 WLH grower chickens of five different batches hatched with a week age difference (interval) reared in 6 houses under intensive deep litter management system, were considered as study population.

Study design and Sample size determination

The study design consists of cross sectional study type andthe sample size was determined based on the assumption of the possible or expected prevalence rate of the disease recorded in the study area which was 38.34% (Lobago et al., 2005). The sample size was calculated based on the formula indicated by (Thrusfield, 2005). Hence, a minimum of 363 birds were considered for this study.

Study methodology

Post mortem examination:Post mortem examination was conducted on these randomly selected 638 dead birds following the procedure described by Conway and McKenzie (2007)and the gastro intestinal tract was thoroughly examined for gross pathological changes as described by Lobago et al. (2005) and Gari et al. (2008). The examination was performed on a daily basis and the findings of each age group were registered from day 1 to day 60.

Mucosal scraping examination

Mucosal scrapings to demonstrate the parasite developmental stages of coccidia along with lesions by microscopic examination were done according to Lobago et al. (2005).

Histopathological examination

Tissue samples of intestines about 1-3 cm length were collected and submitted to the pathology section of the Faculty of Veterinary Medicine, University of Gondar and processed for histopathological examination according to Luna (1968).

Identification of species of coccidian

Eimeria species were identified morphologicallyand histopathologically based on the identification characteristics given by Conway and McKenzie (2007).

Data Analysis

The data were analyzed using SPSS version-17 statistical software. Pearson's Chi square test has been used to measure statistical significance of results. In order to consider a result to be statistically significant 95% CI and *p*-value < 0.05 has been taken.

RESULTS

Prevalence and Eimeria species identification

Out of the 638 sampled dead birds clinical coccidiosis was found in 142 (22.3%) birds. Of these, clinical coccidiosis positive cases of 0 %, 0%, 16.5%, 51.4%, 67.3%, and 41.0 % were found from 1-10 days, 11 – 20 days, 21-30 days, 31-40 days, 41-50 days and 51-60 days of age, respectively. There were no cases in the first twenty days of age. The highest number of clinical coccidiosis cases (67.3%) were, recorded at age 41-50 days. There was a statistically significant difference ($p < 0.05$) in the prevalence of coccidiosis at different age of birds (Table 1).

In the current study, five Eimeria species, namely *E. acervulina*, *E. necatrix*, *E. brunetti*, *E. tenella* and *E. maxima* were identified in single infections. Mixed infections were the predominant cases recorded due to *E. tenella* together with any of the four species (*E. brunetti*, *E. necatrix*, *E. acervulina* and rarely with *E. maxima*) as shown in Table 3. The distribution and occurrence of Eimeria species at different age groups as either single or mixed infections were significantly different $p < 0.05$ as revealed in Table 2.Regarding the temporal distribution of the Eimeria species identified, either as single or mixed-

Table 1. Mortality rates due to Coccidiosis of White Leghorn grower chickens inKombolcha poultry farm in 2009/2010

Age group	No. examined	No. of positive	Prevalence (%)	95% CI
1-10 days	224	0	0 %	0 - 0.0169
11-20 days	102	0	0%	0 - 0.0363
21-30 days	79	13	16.5 %	0.0988 - 0.2615
31-40 days	37	19	51.4 %	0.3589 - 0.6655
41-50 days	113	76	67.3 %	0.5816 - 0.7522
51-60 days	83	34	41.0 %	0.3101 - 0.5171
Total	638	142	22.3 %	0.1920 - 0.2565

$\chi^2 = 261.995^a$, $df = 5$; p value = 0.000

Table 2. Distribution of Eimeria Species at different age of birds (n = 142) in Kombolcha poultry farm in 2009/2010

Species of Eimeria	Distribution of Coccidian species at different age of birds						Total Percentage	95% CI	χ^2 (p – value)
	1-10 days	11-20 days	21-30 days	31-40 days	41-50 days	51-60 days			
E. acervulina	0 (0 %)	0 (0 %)	2 (2.5%)	2 (5.4%)	23 (20.4%)	10 (12.0%)	37 (15.22%)	0.1126-0.2029	71.374 (0.000)
E. maxima	0 (0 %)	0 (0 %)	2 (2.5%)	1 (2.7%)	7(6.2%)	3 (3.6%)	13 (5.35%)	0.0315-0.0894	17.776 (0.003)
E. necatrix	0 (0 %)	0 (0 %)	0 (0 %)	5 (13.5%)	18 (15.9%)	7 (8.4%)	30 (12.35%)	0.0879-0.1708	60.758 (0.000)
E. brunette	0 (0 %)	0 (0 %)	8(10.1%)	11 (29.7%)	36 (31.9%)	16 (19.3%)	71 (29.22%)	0.2386-0.3523	108.518 (0.000)
E. tenella	0 (0 %)	0 (0 %)	7 (8.9%)	11 (29.7%)	53 (46.9%)	21 (25.3%)	92 (37.86%)	0.0844-0.1661	168.514 (0.000)
Total	0 (0 %)	0 (0 %)	19(7.8%)	30(12.34)	137(56.4%)	57(23.46%)	243(100%)		

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-infections at different age of birds, *E. tenella* and *E. brunetti*, occurred most frequently with prevalence of 37.86% and 29.22%, respectively. Whereas the rest three species identified, *E. acervalina*, *E. necatrix* and *E. maxima* were low in prevalence and accounts prevalence rates of 15.22%, 12.35%, and 5.35%, respectively as shown in Table 2. This difference was statistically significant $p< 0.05$ as depicted in Table 2. *E. maxima* were diagnosed for the first time in the current study in this study area in- spite of the limitations encountered during the study period. It was the largest in size, ovoid in shape and has golden brown colour observed during microscopic examinations of mucosal scraping smears taken from the middle small intestine. Moreover, histopathological examination results revealed large gametocytes.

Table 3. Frequency of distribution of Eimeria species as single and mixed infections (n = 142) in Kombolcha poultry farm in 2009/2010

Eimeria species as single and mixed infections	Frequency of Distribution n (%)
E. acervulina	14 (9.9 %)
E. maxima	3 (2.11 %)
E. necatrix	6 (4.22 %)
E. tenella	16 (11.26 %)
E. brunetii	24 (16.9 %)
E. acervulina + E. maxima	3 (2.11 %)
E. tenella + E. acervulina	10 (7.04 %)
E. tenella + E. brunetii	38 (26.76 %)
E. tenella + E. necatrix	16 (11.26 %)
E. tenella+ E. acervulina + E. maxima	2 (1.41 %)
E. tenella + E. acervulina + E. necatrix	1 (0.70 %)
E. tenella + E. necatrix + E. brunetii	2 (1.41 %)
E. tenella + E. brunetti + E. acervulina + E. necatrix	2 (1.41 %)
E. tenella + E. brunetti + E. acervulina + E. maxima	2 (1.41 %)
E. tenella + E. brunetti + E. acervulina + E. necatrix + E. maxima	3 (2.11 %)
Total	142 (100 %)

Note: Single infections = 63/142 (44.37 %); Mixed infections = 79/142 (55.63 %)

Cannibalism, high stocking density, inadequate cleaning of utensils, absence of isolation pen (mixing of sick and healthy birds in a house), defective feeders and waterers which allow the birds to enter in to the utensils and defecate in them, defective or mistaken inclusion of anti coccidial drugs in feed/water and the deep litter system (quality of the litter/infrequent change and turning of the litter) were identified as the main predisposing factors responsible for the prevalence of coccidiosis (22.3 %) in the present study.

DISCUSSION

The results of the present study illustrate that the disease coccidiosis is still prevalent in KPBMC with prevalence rate of 22.3% (142/638) in dead sampled White leghorn (WLH) grower chickens of age 1-60 days. It was observed that there was a statistically significant difference ($p < 0.05$) in the prevalence of coccidiosis among the six different age groups examined. When compared with the results obtained from the previous researches done in Ethiopia that reported prevalence rates of 48.2 % (Methusela, 2001), 36.78 % (Dereje, 2000) and 38.34 % (Lobago et al. 2005) in deep litter management systems, the present prevalence study was reduced markedly. The prevalence of clinical coccidiosis in the present study has decreased by approximately two-fifth of the previous prevalence reported by Lobago et al. (2005) in dead RIR chickens 1-60 days of age in the study site. This high reduction of prevalence of coccidiosis observed in the current study may be ascribed mainly to the application of preventive measures which basically rely on the use of anticoccidial drugs that were given at early ages starting from the second weeks of age for duration of 7 to 14 days of the growing periods. This may be also due to breed difference as the previous study had been done on RIR breeds. Another reason may be due to the slight improvement of the management system and bio security measures when compared to the setup in the previous study (Lobago et al., 2005). There was an improvement in the stocking density with an observed range of 8.43 birds / m^2 to 16.71 birds / m^2 which normally was expected to be between 10-15 birds / m^2 (Hamet et al., 1982). However, the prevalence of clinical coccidiosis 22.3% in the present study was attributed to the absence of isolation pen, occurrence of cannibalism (vent picking) and some managerial errors such as defective feeders and waterers that increase the risk of litter contamination and oocyst build-up and higher litters moisture.

The results of the present study is in consistent with the findings of Gari et al. (2008) and Tehetena (2010), who assessed prevalence rates of 22.58% in deep litter system and 23.1% in small and large scale production systems in Ethiopia, respectively. Although the disease coccidiosis appeared to occur for the first

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time since 28th day of age, the highest frequency occurred in the age group between 41-50 days (6-7 weeks). This finding is in congruent with the findings of other authors and researchers regarding the frequency occurrence of clinical coccidiosis with respect to the age of birds (Methusela, 2001; Lobago et al., 2005; Taylor et al., 2007). This was because most coccidian infections occur at the age of 3-4 weeks but clinical diseases develop one or more weeks later. As a result the clinical diseases appear to reach climax at 5-7 weeks of age and as the age exceeded 7 weeks, most birds will develop immunity against thediseases. However, this period may be prolonged by mistaken /defective use of anticoccidial drugs; hence a slight change was observed in the frequency of occurrence of clinical coccidiosis in that the peak of the disease was observed at the age of 41-50 days (6-7 weeks) unlike the findings of Lobago et al. (2005).

Five Eimeria species were identified, namely, *E. acervulina*, *E. necatrix*, *E. brunetti*, *E. tenella* and *E. maxima*. There was a significant variation in distribution or frequency of occurrence of these identified species with respect to age ($p< 0.05$). In all species the maximum prevalence was observed at the age of 41 to 51 days (6-7 weeks), which is true with *E. tenella* infection which generally affects chicks below 10 weeks of age with maximum prevalence in 4 to 8 weeks old chicks, but in chicks below 2 weeks it is rarely seen (Chauhan and Roy, 2007), whilst older birds are generally immune as a result of prior infection (Hafez 2008); and the infections with *E. acervulina*and *E. maxima* are seen at 3 - 6 weeks of age and then *E. necatrix*at 8 - 18 weeks of age, whereas *E. brunetti*is seen both early and late (McDougald, 2003).

However, in the previous work, four Eimeriaspecies namely, *E. acervulina*, *E. necatrix*, *E. brunetti*and *E. tenella* (Lobago et al. 2005), were reported in this study area and the current finding adds the fifth species *E.maxima* which was diagnosed for the first time as one of the prevalent Eimeria species in the study site. *E. maxima* were found to be the first diagnosed species of Eimeria in this study area. This can probably be either due to the prophylaxis use of anticoccidial drugs in feed or water, which were observed during the study period or presumably due to emergence of drug resistance in which the most frequently given drug being amprolium, which is usually effective for control of *E. tenella* and *E. brunette* (Lobago et al., 2005), or may be due to breed difference. It is likely that resistance has developed to more recent anticoccidial drugs (Chapman, 2005) and very few drugs are equally efficacious against all *Eimeria species* (McDougald, 2003), the occurrence and incidence of disease is also, to a great extent affected by the type of chicks reared and breed sensitivities to infection (Taylor et al. 2007). The practice of feeding premixed coccidiostats to poultry in large poultry-raising and production establishments has reduced the significance of *E. tenella* and *E. necatrix*and emphasized the importance of other species, such as *E. maxima*. Moreover, many coccidiostatic drugs have been directed against *E. tenella*, with the result that other species are increasingly incriminated as a cause of poultry coccidiosis (Urquhart et al., 1996). Nevertheless, this finding is in agreement with the previous researchers reports (Methusela et al., 2002; Ashenafi et al., 2004; Gari et al., 2008) who investigated *E. maxima* in Ethiopia. The gross and histopathological changes observed for each species were quite similar to what was previously described in other studies (McDougald, 2003; Williams, 2005; Haug et al., 2008; Amer et al., 2010). The unusual findings of the intestinal intussusceptions in *E. maxima* and *E. necatrix* infections in the present study might be occasionally misdiagnosed as coccidiosis, particularly when concomitant with coccidiasis (Catchpole, 2000) and necrotic enteritis (Wages and Opengart 2003). Nevertheless, the finding of the intestinal intussusceptions in this study was confirmed by mucosal scraping examination and histopathology and found that it was due to coccidiosis.

CONCLUSION

Despite the reduction in the prevalence of coccidiosis in the present study, coccidiosis is still a major burden to poultry producers and veterinary health professionals in the farm by changing its mode of occurrence from time to time as to the variation in the conditions of the management system. Hence, demanding a lot of interventions and research to develop long-lasting and sustainable prevention and control strategies so as to get rid of the disease.

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