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Asian Journal of Animal and Veterinary Advances



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## **Clinico-Pathological Study of Avian Coccidiosis and its Economical Impact on Small Scale Poultry Farming in Selected Districts of Tigray, Ethiopia**

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### **ABSTRACT**

Despite the economic significance of coccidiosis in the study area (Tigray region, Ethiopia), no substantial research have been done. Hence, the present study was designed to provide information on the clinico-pathology and socioeconomic impacts of avian coccidiosis on chickens farmed under small-scale system. Clinico-pathomorphological study, morphometric Oocyte Per Gram (OPG) determination and questionnaire survey were done. Out of 2000 chicken populations, 350 (17.5%) showed clinical coccidiosis clinico-pathomorphological study and 5% mortality rate was reported. The major clinical findings were depression, bloody diarrhea, mucoid droppings and loss of production. Eleven percent of birds examined through necropsy showed mild to moderate thickened, wrinkled and edematous intestinal wall with multiple focal, ecchymotic haemorrhage and congestion and with mucoid content. Seven percent of samples reported to have greatly enlarged and distended caecal pouch with clotted blood and diffused haemorrhagic enteritis. Histopathological examinations of 8.5% of the representative tissue sections showed numerous oocytes invading the mucosal and submucosa layers, loss of enterocytes, hemorrhage, necrosis of mucosal layer, infiltration of heterophils and lymphocytes in the submucosal, desquamation and blunting of villi. On morphometric examination, out of 96, 31 and 51 droppings, litter and intestinal content samples, 66 (68.75%), 8 (25.81%) and 39 (76.47%) were found positive for coccidian oocytes, respectively. The questionnaire based survey indicated an estimated 1,375 Birr loss per farm per month due to coccidiosis. Risk factors such as poultry farmers/employees with little background on poultry production and poor litter management were found to favour the occurrence of avian coccidiosis. Integrative poultry producer education/extension service and participatory coccidiosis control and prevention approaches need to be in place.

**Key words:** Avian coccidiosis, chicken, economic loss, enteritis

### **INTRODUCTION**

In Ethiopia, poultry farming is being progressed from a traditional backyard rearing to an organized small-scale and medium-scale commercial venture in the last decade. Currently, there is huge demand of poultry meat and eggs which is higher as compared to the supply. Hence, there is an emerging establishment and expansion of modern and organized poultry

farms in the entire country particularly in peri-urban and urban areas (FAO, 1998; Kinunghi *et al.*, 2004). In the year 2008-09, a total of 44, 889 and 14, 914 holders in Ethiopia and Tigray, respectively were engaged in poultry development packages (CSA, 2010). Thereby, it has been becoming a major source of income and gives great opportunities of employing hundred thousands of unemployed citizens and helping poverty alleviation and food security at large (CSA, 2010).

However, the poultry farming has been adversely affected by a variety of constraints (FAO, 1998). Of these constraints, poultry diseases and health problems continue to play the major central role in hampering its development, value and profitability, particularly to small-scale poultry farming (FAO, 1998; Rushton *et al.*, 1999). It was reported that in the year 2008-09, a total of 17,784,039 and 1,660,853 poultry in Ethiopia and Tigray regional state, respectively were died of diseases (CSA, 2010).

Avian coccidiosis caused by protozoan organisms, *Eimeria* which is characterized by enteritis, debility and anaemia and is one of the most economically important diseases of poultry in worldwide. In commercial poultry flocks, it is responsible for 6-10% mortality and an estimated global economic loss of 2 billion USD annually due to reduction in egg production, growth rate, feed intake and feed-conversion efficiency (Banfield *et al.*, 1999). In Ethiopia, available evidences witness that poultry mortalities due to diseases are estimated to be 20-50% where avian coccidiosis is one of the major diseases causing significant poultry losses (Kinunghi *et al.*, 2004; Lobago *et al.*, 2005). It is used to be the most important cause of mortalities in all farms and continued to be a problem as reported by various investigators (Fessesse-Work, 1990; Kalifa, 1997; Hagos, 2000; Kinunghi *et al.*, 2004).

It has been observed that coccidiosis is major problem to the organized small-scale poultry farming due to high stock density and suitable micro-environment. Its impact is exaggerated by multifaceted poor health and management factors like poor and unhygienic housing, feeding, poor litter management, lack of knowledge of poultry health and absence of consultancy and research. In the contrary, despite the economic significance of coccidiosis in the country and Tigray region, no substantial research has been done on the disease. Hence, the present study was designed to provide information on the clinico-pathology and socioeconomic impacts of avian coccidiosis in small-scale poultry farming in Tigray regional state, Ethiopia. The findings of this study were believed to help farmers, policy makers, politicians and researchers in designing and implementing coccidiosis control strategies and improve the poultry farming. The objectives of this study are give below:

- Assessment of the importance of avian coccidiosis in small-scale poultry farming through:
  - Detecting and determining oocyte out put in faeces, litter and intestinal contents
  - Necropsy and histopathological examination of pathological lesions in the gastrointestinal tract of birds, resulted from coccidiosis
  - Estimating the economic impact and expected losses attributed by coccidiosis to the small-scale poultry farming development in the districts

## **MATERIALS AND METHODS**

**Clinico-Pathomorphological study:** During the longitudinal study on 31 flocks in purposely selected three districts, sick birds were closely examined for clinical manifestations suggestive of coccidiosis and the clinical signs and mortality rates were recorded.

Detailed necropsy examination was carried out on randomly selected clinically sick and died birds suspected of coccidiosis. The presence of gross lesions was carefully recorded and representative pieces of intestines were collected in 10% buffered neutral formalin. Paraffin sections of approximately 5 $\mu$  thickness were prepared and the tissue sections were stained with haematoxylin and eosin (Luna, 1968) for histopathological study in the Veterinary pathology laboratory, Mekelle University. Every microscopic lesion was carefully described, analyzed and recorded.

**Detection of oocytes using morphometric technique:** To evaluate the Oocytes Per Gram (OPG) of faeces, litter and intestinal content samples were collected every two weeks. The samples were preserved in 4°C and examined using a standard McMaster technique (Haug *et al.*, 2008). Level and severity of infestation were also determined by comparing the calculated OPG output and standard values as light (<10,000 oocytes), moderate (10,000-15,000 oocytes) and higher (>15,000 oocytes) (Lunden *et al.*, 2000).

**Questionnaire survey:** To assess the economic losses due to coccidiosis, a well designed questionnaire format was used to obtain information from interviewees and farm records. It was also used to assess the farmer's awareness towards the disease and its impact on flock performance. The economic impact was determined by considering production, treatment related and other costs which have been referred to as negative inputs (Thrusfield, 2005). Risk factors like litter condition and other management practices which were assumed to be predisposing factor for the occurrence of coccidiosis were also assessed.

**Statistical analysis:** The generated primary and secondary data were entered and managed in Excel Microsoft spread sheet, analyzed using Excel Microsoft, SPSS version 14 and Graph Pad Prism version 4 statistical packages. Comparison of descriptive statistics and correlations (Chi square test) was done to test if statistically significant association exists between potential risk factors with occurrence of coccidiosis. For all the analyses performed,  $p < 0.05$  was taken as statistically significant.

## **RESULTS**

**Clinico-pathological study:** The clinico-pathological study revealed that from the total 20 flocks with 2000 chicken populations, 350 sick chickens showed depression, bloody diarrhea, mucoid droppings (Fig. 1a-d) and loss of production and out of which 5% were died. Accordingly the prevalence of clinical coccidiosis was calculated to be 17.5% (350/2000).

Out of the 5 dead and 56 sacrificed chickens where necropsy examination was conducted 11% showed gross lesions suggestive of coccidiosis. Mild to moderate thickened, wrinkled and edematous intestinal wall with multiple focal, ecchymotic hemorrhage and congestion and with mucoid content were the major gross lesions detected. Seven percent of samples reported to have greatly enlarged and distended caecal pouch with clotted blood and diffused haemorrhagic enteritis (Fig. 2a-d).



Fig. 1(a-d): Clinical signs observed in sick chickens; (a-c) Mucoid diarrhea and (d) Depression

Similarly, histopathological examinations of 8.5% of the representative tissue sections showed numerous oocytes invading the mucosal and submucosa layers, loss of enterocytes, hemorrhage, necrosis of mucosal layer, infiltration of heterophils and lymphocytes in the submucosal, desquamation and blunting of villi (Fig. 2e-f).

The severity of the macroscopic and microscopic lesions was higher in caecal portion of the large intestine of chickens 3-6 weeks of age and kept in floor system (full litter system).

**Determination of infection level using morphometric OPG analysis:** The infection level, measured as Oocyte Per Gram (OPG) of sample was determined using standard McMaster technique. Accordingly, from a total of 96, 31 and 51 faeces, litter and intestinal content samples, 66 (68.75%), 8 (25.81%) and 39 (76.47%), respectively were found positive for eimeria oocytes. The OPG values as compared to standard values showed that out of the total 66 positive litter samples, 17 (17.71%) were with high infection rate. Similarly, out of the total 39 positive samples of intestinal contents, 7 (13.73%) were with higher infection rate. The details of the findings of the morphometric OPG analysis are given in Table 1.

**Socioeconomic impact and risk factors of avian coccidiosis:** During the questionnaire survey conducted, poultry farm owners and employees were interviewed to obtain information on socioeconomic importance of poultry, predisposing risk factors, occurrence and socioeconomic impacts of avian coccidiosis. The findings showed that a mean total of 1375 Ethiopian Birr was reported to



Fig. 2(a-f): Macroscopic and microscopic lesions observed in dead and sacrificed sick chickens; (a) Caecal pouch greatly enlarged and distended with clotted blood, (b) Diffused haemorrhagic enteritis, (c-d) Thickened, wrinkled and edematous intestinal wall with multiple focal ecchymotic haemorrhage and congestion, (e) Numerous oocysts invaded mucosal layer and loss of enterocytes and (f) Necrosis of mucosal layer, desquamation and blunting of villi

Table 1: OPG outputs in faeces, litter and intestinal contents and level of eimeria infections

Type of samples	No. of total samples	No. of positive samples	Prevalence	Mean OPG	Level of infection
Faeces	96	28	29.17	5560.32	Light
		21	21.88	12750	Moderate
		17	17.71	15600	Higher
		66	68.75		
Litter	31	8	25.81	3450	Light
Intestinal contents	51	19	37.25	6750	Light
		13	25.49	13560	Moderate
		7	13.73	17450	Higher
		39	76.47		

OPG: Oocyte per gram of faeces

Table 2: Associations exist among risk factors and the occurrence of avian coccidiosis

Risk factors	Prevalence of coccidiosis	Correlation
<b>Education level</b>		
Illiterate	25.86	$\chi^2 = 0.05186, p = 0.0139$
1-4 grade	18.97	
5-8 grade	13.79	
10-12 grade	15.52	
Diploma/certificate	18.97	
Degree and above	6.89	
<b>Breed</b>		
Local	36.21	$\chi^2 = 0.1143, p = 0.0002$
Hybrid	18.96	
Exotic	39.66	
Both local and exotic	5.172	
<b>Poultry house type</b>		
Night enclosure only	62.07	$\chi^2 = 0.03174, p = 0.0557$
All time house	37.93	
<b>Litter use</b>		
Yes	74.14	$\chi^2 = 0.07898, p < 0.0022$
No	25.86	
<b>Method of hygiene keeping of poultry house</b>		
Chemical	6.89	$\chi^2 = 0.02944, p = 0.0022$
Simple cleaning	84.48	
Not done	3.45	
chemical and simple cleaning	5.17	
<b>Method of coccidiosis prevent/control</b>		
Traditional medicine	1.72	$\chi^2 = 0.01384, p = 0.2086$
Veterinary service	60.34	
Sale	0	
Cleaning	0	
No action	37.93	
<b>Veterinary services access</b>		
Yes	43.1	$\chi^2 = 0.07047, p = 0.004$
No	56.89	

be lost monthly/farm due to avian coccidiosis. The major reasons for the economic loss include loss of egg and meat production, veterinary drugs and inputs, management and litter costs.

Risk factors such as low education level of owners/employees, breed of chickens, use of litter and lack of access to veterinary services were reported to have statistically significant associations with avian coccidiosis occurrence (Table 2).

Table 3: Socioeconomic importance of poultry and monthly economic losses incurred due to avian coccidiosis (Birr/farm)

Parameters	Minimum	Maximum	Mean	Standard deviation
<b>Socioeconomic importance</b>				
Number of employees/farm	1	6	1.31	0.78
Eggs produced/bird/month	6	60	22.48	11.23
Price of broiler chicken	40	80	59.91	10.61
<b>Losses incurred</b>				
Body weight loss	0	1560	225.62	381.59
Egg production reduction	0	1600	139.09	263.42
Death of chickens	0	5700	249.46	780.19
Veterinary services costs	0	2200	352.03	560.61
Management cost	0	2050	73.83	321.48
Litter cost	0	1200	215.09	1567.78
Average lost (birr/farm/month)			1255.12	

Table 4: Characteristics and status of the small scale poultry farm

Parameters	Frequency	Percentage
<b>Farm location</b>		
Urban	116	100
Peri-urban	0	0
Rural	0	0
Total	116	100
<b>Farm size</b>		
10-50 birds	68	58.62
50-200	44	37.93
200-500	2	1.72
50-1000	0	0
>1000	2	1.72
Total	116	100
<b>Breed</b>		
Local	42	36.21
Hybrid	22	18.97
Exotic	46	39.66
Both local and exotic	6	5.17
Total	116	100

Table 3 provides that a layer chicken was found to produce 22 eggs per month on average and similarly, the average price of a broiler was calculated to be 59.91 Birr. A total of 1375 Birr was calculated as average loss incurred due to coccidiosis (Table 4). On the other hand, the age group of majority of the farm owners and employees was recorded to be between 30 to 50 years and the highest population of them were illiterate and on few were with diploma and above. The details of the questionnaire survey results are summarized in Table 2-4.

## DISCUSSION

Sick chickens showed depression, bloody diarrhea, mucoid droppings and loss of production and with 5% mortality rate and 17.5% prevalence of clinical coccidiosis. Similar clinical signs, prevalence of clinical coccidiosis and mortality rates were also reported (Banfield *et al.*, 1999; Waldenstedt *et al.*, 2000). However, Lobago *et al.* (2005) reported higher prevalence rate (38.34%) of clinical coccidiosis in one farm, Kombelcha Poultry Multiplication Center of Ethiopia.



The macroscopic lesions such as mild to moderate thickened, wrinkled and edematous intestinal wall with multiple focal, ecchymotic hemorrhage and congestion were reported in the present study. Additionally, greatly enlarged and distended caecal pouch with clotted blood and diffused haemorrhagic enteritis were seen. Numerous oocytes invading the mucosal and submucosa layers, loss of enterocytes, hemorrhage, necrosis of mucosal layer, infiltration of heterophils and lymphocytes in the submucosa, desquamation and blunting of villi were typical lesions of avian coccidiosis recorded microscopically. These lesions might have been caused by invasion of sporulated oocytes during their reproduction and development. But other factors such as concurrent bacterial infection might have also contributed for the development of the lesions (Waldenstedt *et al.*, 2000). The variation in severity, type and location of the lesions might have been due to the variation in predilection site and pathogenicity of the eimeria species. Similar lesions have also been reported by many previous workers (Banfield *et al.*, 1999; Kinunghi *et al.*, 2004; Vegad and Katyar, 2007). The infection level, measured as OPG of sample, revealed that 17.71 and 13.73% of faeces and intestinal content samples were with high infection rate (>1500 oocytes). Findings of Lunden *et al.* (2000) also support the present finding.

The findings of socioeconomic impact assessment showed that coccidiosis had all rounded impact on the productivity and profitability of the small-scale poultry farming whereby a total of 1375 Ethiopian Birr/monthly/farm is lost due to the disease. Similarly, Kinunghi *et al.* (2004) studied that coccidiosis contributed to an average of 11.86% loss in enterprise profit per farm and proportional mortality rates of 14.5% in small scale poultry farms, in Debre Zeit, Ethiopia. This includes both direct and indirect losses which occurred in the form of mortalities, coccidiostat costs, reduced weight gains, reduced market value of affected birds, delayed off take and reduced egg production in layers.

The severity and pathogenesis of coccidiosis is highly dependent on internal and external (environmental) factors. The potential predisposing factors of coccidiosis include education level of owners/employees, breed of chickens, use of litter and access to veterinary services. This is meant that poultry owners/employees with low educational background owned, exotic breed of chickens, chickens reared in older and wet litter systems and without access to veterinary services suffer more than other groups. This is also supported by Lunden *et al.* (2000) and Kinunghi *et al.* (2004).

## CONCLUSION

The clinico-pathological study, OPG determination and questionnaire survey of this study indicated that avian coccidiosis is very important disease of chickens reared under small-scale farming in the study area. Low level of education and technical knowledge of owners and employees, poor veterinary access and inputs and coccidiosis management practices and weak integrated and systematic coccidiosis surveillance and control activities could be the root factors for the high prevalence of coccidiosis and its socioeconomics impacts on the small scale poultry development packages across the study area.

Therefore, integrated poultry producer education/extension service, sustainable, integrated and participatory coccidiosis control and prevention approach and protocols, poultry healthcare service should be available and improved. Further study on treatment, control and prevention methods of coccidiosis and its interactions with concurrent diseases need to be done to have better control options for the disease and hence, improve the productivity and profitability of this poultry development in the area. In general, modern poultry rearing practices and necessary inputs should be introduced and established in to the area so, as to significantly reduce the impact of coccidiosis.

## ACKNOWLEDGMENTS

The authors are thankful to Mekelle University College of Veterinary Medicine for financial and technical support provided for the successful completion of the project. The authors also would like to extend their appreciation to the poultry owners and their employees and experts who were involved during the implementation of the project, for their all rounded support.

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