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The Effects of Breed and Age of Chicken on the Amount of Faecal Excretion of *Eimeria* Oocystes and Mortality Rate Due to Coccidiosis

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Abstract

The effects of breed and age on faecal output of *Eimeria* oocystes and mortality rate due to coccidiosis was studied on 180 chickens from three breeds (60 each) namely; local (normal and necked-neck), Babcock (50% crossed with White leghorn) and White leghorns. The chickens were categorized into three groups, each again categorized into three subgroups each consisting 20 chickens from each breed. Identification and enumeration of *Eimeria* oocystes were made from fresh fecal samples and coccidiosis was diagnosed based on postmortem lesions and detection of the parasite's developmental stages from tissue smears. The overall mortality rate due to coccidiosis reported in this work was estimated to be 58%. The variation in mortality rate among the breeds was significant ($p< 0.01$); White leghorn was affected at higher rate (81.7%) compared to the Babcock (50%) and local breed (41.6%). Generally, a steady decrease in mortality rate over increasing age was reported during the study period ($r=0.5$). The variation in the amount of fecal excretion of *Eimeria* oocystes among the three breeds was significant ($p< 0.005$). WLh excreted relatively higher amount of oocystes compared to the other two breeds. Similarly, age of chickens significantly ($p<0.005$) influenced the amount of oocystes excreted in faeces. Keeping chickens of different breeds and ages in same house would favor the establishment of epidemic coccidiosis in a poultry farm. It was also recommended that resistance to coccidiosis was possible through genetic selection and that appropriate management of local chickens can help reduce incidence of the infection.

Key words. Breed/ Age/chickens/Eimeria oocyste/coccidiosis/ /mortality

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Introduction

In Ethiopia, the population of poultry significantly exceeds that of any other livestock species. According to the ministry of Agriculture, poultry population of the country is estimated to be around 53 million (about 40% of the total livestock population) (Technical Center for Agricultural and Rural Cooperation, CTA, 1997). Chickens are reared almost in all agro-ecological zones predominantly under traditional husbandry system and they constitute vital sources of household cash income and food. Poultry husbandry in an intensive system is also practiced by some urban and peri-urban dwellers.

Diseases are among the major constraints to poultry production in the country. However, information regarding epidemiology is inadequate.

Coccidiosis of chickens is caused by single-celled protozoan parasites that live in the epithelial lining of the intestine, and those affecting chickens are largely due to the species *Eimeria* (David, 1984). Though publications related to poultry coccidiosis in Ethiopia are absent, information obtained from some poultry farms (personal communication) suggested that it is the most prevalent and serious disease of chickens.

In most poultry farms in the country, chickens are usually maintained in same houses irrespective of their ages and breeds. This gives raise to persistent establishment of serious infectious diseases like coccidiosis and their causative agents in the farms. This paper, thus, describes the effects of keeping different breeds and ages of chickens in same house on the amount of faecal excretion of *Eimeria* oocystes and mortality rate due to coccidiosis at a poultry farm of Awassa College of Agriculture.

Materials and Methods

Study area

The study was carried out from May to September 1997 in a poultry farm of Awassa College of Agriculture, Debub University, Awassa town. Awassa is located 275km south of Addis Ababa, the capital of Ethiopia, at a latitude of 7^0 04'N and a longitude of $38^0$31'E and an altitude of 1700m above sea level. The area receives an annual rainfall of 900-1100 mm and temperature ranges from 10^0 to 30.5^0C.

Experimental Animals

Three breeds of chickens were used for this experiment. These were White leghorn, Babcock (50% crossed with White leghorn) and local strain (Normal

and necked-neck). They were mainly kept for educational and research purposes. Chickens were housed in a deep floor system. Although not rat-proof, the houses were adequately ventilated through special ventilator openings of mesh-wire made. Feed and water were provided twice a day during morning and evening. Disease, in particular coccidiosis, is a major production constraint of the farm.

Collection of Faecal Samples

Approximately 5g Faeces was collected daily in petridish directly from the floor using spatula from at least four different places in each pen (Janssen pharmaceutica, 1990). The samples were collected fresh from normal as well as very thin and watery consistent excrements and made to contain as little litter as possible. Collected samples were soon transported to parasitology laboratory of the veterinary section of Awassa College of Agriculture for oocystes identification and enumeration.

Identification and Enumeration of Eimeria Oocystes

In laboratory, samples of each pen were thoroughly mixed to obtain representative samples from the chickens present and the examination reproducible. Oocystes identification and enumeration were made using modified MacMaster's technique (MAFF, 1982). Mean oocystes count of each week for each breed was then estimated from the daily counts. The number of oocystes in the samples was expressed in terms of oocystes per gram of faeces (OPGF).

Diagnosis of Coccidiosis and Estimation of Mortality Rate

Diagnosis of coccidiosis was made by autopsy of representative number of dying chickens and direct examination of the intestinal and caecal faeces for detection of the different developmental stages of the parasite. Daily mortality record, based on breed and age, was taken and the rate was then calculated for each week using a method described by Putt, *et al, (*1987).

Experimental Design

Day-old chickens (n=180) (60 chickens from each of the three breeds) were directly transferred from hatching room to a pre-emptied house. The chickens were categorized into three groups (G1, G2 and G3) and maintained in separate pens. Each group (n=60) again was categorized into three subgroups each consisting 20 chickens from each of the three breeds and maintained in sub spaces within each pen. This was made to avoid the potential effects resulting from variation in housing and management conditions. The house

was uniformly supplied with light power and feeding and watering conditions were also made uniform for all the groups.

Statistical Analysis

The effects of breed and age of chickens on mean faecal output of *Eimeria* oocystes were assessed using analysis of variance (Systat version 7.0.1, SPSS Inc, 1997). Linear regression was used to estimate the trend of relationship between age and overall mortality of the infection and mean faecal oocystes counts. The degree of association between mortality of the infection and breed was assessed using chi-square independent test (Gupta, 1985). The coefficient of variations of mean oocystes count per gram of faeces for different age and group categories as well as the trend in the amount of oocystes output and mortality over age trend were assessed using descriptive statistics (Systat version 7.0.1, SPSS Inc, 1997)

Results

Table 1 shows mortality rate due to coccidiosis in the three breeds of chickens. Significant ($p<0.05$) variation in mortality rate was observed among the breeds. White leghorn (WLh) was affected at much higher rate (81.%) than local (41.6%) and cross-bred (50%) chickens. Again, comparing the overall mortality cases reported during the study period, WLh shared higher proportional mortality (47%) than Babcock (29%) and local (24%) breeds.

In this study, it was reported that more than half (58.3%) the chickens had died of Coccidiosis. The incidence was particularly higher (81%) in the age range between 5th to 10th weeks; the highest rate being 14.4% at the 5th week of age and declined steadily then after. No death case was reported after 13th week. The trend in mortality rate over an increasing age is shown in figure 2.

Table1. Mortality due to coccidiosis in White leghorn, Babcock x white leghorn and normal and necked-neck chickens at the poultry farm of Awassa college of Agriculture

Breed	Number examined	Death	Percent
Normal and necked–neck	60	26	41.6
Babcock x white leghorn	60	30	50
White leghorn	60	49	81.7
Total	180	105	58.3

P<0.01(significant)

The regression of overall mortality rate due to coccidiosis on increasing age is shown in figure 1. Generally, steady regression of mortality over increasing age was observed during the study period (R^2=0.2764), though the relationship appeared positive (r=0.525).

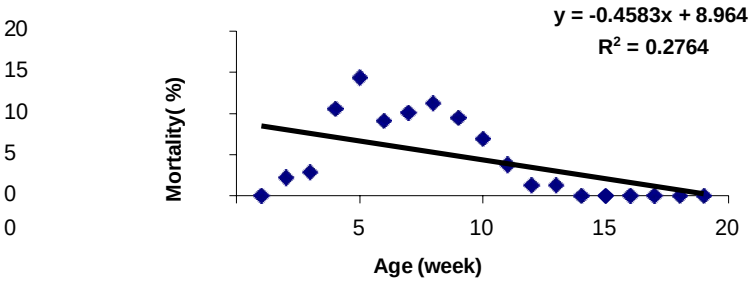

Figure 1.The regression of overall mortality due to coccidiosis over increasing age of chickens

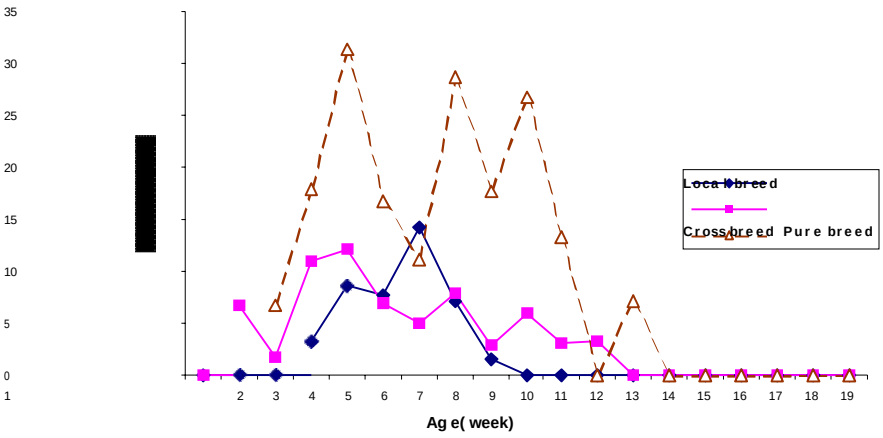

Figure 2. Trend in mortality rate over increasing age chickens.

Figure 3 shows linear relationship of mean faecal oocyste concentration and increasing age. Although the age mark at which the highest faecal concentration of oocystes was encountered and the concentration started to decline then after varied among the breeds, the linear relationship between the amount of oocystes output and age generally appeared negative (R=0.18).

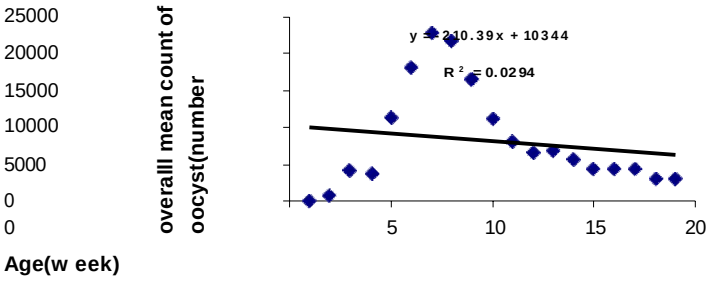

Figure 3. The regression of overall mean faecal oocyste out put over increasing age

Figure 4 shows trend in mean faecal out put of oocysts over an increasing age. Generally, the oocysts count sharply increased starting from the 2nd week and attained the highest count from 6th up to 9th week (about 47% of the overall oocyste concentration was encountered in this age range) and it started to decline steadily then after (The mean range of overall oocystes count was around 1.0290×10^4). No significant oocystes were recovered from faecal samples collected at the 1st week of the experiment. For local breed, faecal oocystes excretion was observed lately (around the 4th week) while crossbred and WLh started the excretion relatively at earlier time (around the 2 nd and 3rd week, respectively).

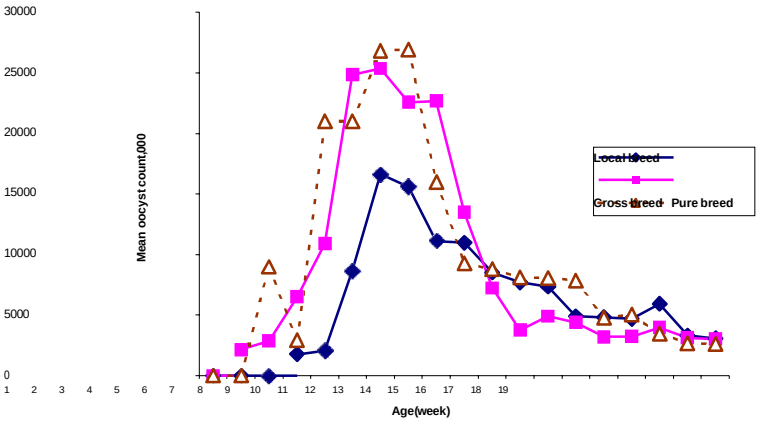

Figure 4. The trend in mean faecal output of *Eimeria* Oocystes over increasing age of chickens

The effects of breed and age of chickens on the amount of faecal excretion of *Eimeria* oocystes are shown in table 2. Significant ($p<0.005$) variation in

faecal oocyste concentration was reported among the breeds WLh excreted relatively high amount of oocystes (37%) during the study period compared to low faecal output (28%) of local breed. Similarly, age had significantly (P<0.005) influenced the amount of oocystes excreted in faeces.

Table 2. Analysis of variance for the effects of breed and age of chickens on the amount of faecal output of *Eimeria* oocystes

Source	Sum-of-Squares	DF	Mean-Square	F-ratio	P
Breed	3.34099E+08	2	1.67050E+08	16.810	0.0002*
Age	7.92841E+09	18	4.40467E+08	44.323	0.0004**
Group	693.203	2	346.602	0.000	0.999***
Error	1.47078E+09	148	9937687.659		

*P<0.001, **P<0.001, ***p>0.5.

Table 3 shows coefficient of variation of faecal oocystes count of the three groups. Grouping of chickens didn't show any significant effect (p>0.5) on variation in oocystes count Likewise, oocystes count among the subgroups with in the three groups for each breed is insignificant.

Table 3. Coefficient of variation of mean faecal oocystes counts of the three groups

Breed	Group1	Group2	Group 3	Range	Sum	Mean	S.D	C.V
Local	6234.2	6225.4	6049.13	185.07	18508.73	6169.6	104.4	0.017
Cross	8730	8828	8999.7	269.7	26557.7	8852.6	136.5	0.015
Pure	39345.9	39430	40450.3	1104.3	119226.28	39742.0	614.7	0.015

Discussion

In this study, 58% overall mortality rate due to coccidiosis was estimated, though significant variation occurred among the breeds. Different researchers reported different mortality rates of coccidiosis under different management conditions. A flock mortality of 10% and 20% had been reported by Malcolm (1978). On the other hand, Edigar and Siebold (1964) reported mortality rate of 70% in an intensive farm. Soulsby (1982) also described that when young birds were placed on heavily contaminated litter, as high as 100% mortality could occur. This variation in mortality rate due to coccidiosis can be attributed, interalia, to pathogencity of the parasite involved, nature of the host (Soulsby, 1982) and difference in management system.

In this work, clinical and post mortem examinations of representative samples of birds revealed the predominance of *Eimeria tenella* and *Eimeria*

nicatrix though the involvement of other species such as *Eimeria acervulina* was also evident. In fact, caecal and intestinal coccidiosis have been the most serious health problems of chickens in the poultry farm of the college (Arega, personal communication). This finding agrees with that of Soulsby, 1982; Malcolm, 1978; Gordon & Jordan, 1982 and David, 1984 who reported that *Eimeria tenella* and *Eimeria nicatrix* were the major pathogenic species in several outbreaks of coccidiosis despite the involvement of some other species as part of mixed infection.

Breed had significantly ($p<0.001$) influenced the amount of faecal oocystes output and mortality rate due to coccidiosis ($P<0.01$). Pure White leghorn was found having higher fecal oocystes concentration (37%) and more affected by the infection (81.7%) than were Babcock and local breeds. Susceptibility and resistance of different breeds and outbred lines of birds against coccidiosis had been reported by several researchers (Gordon&Jonson, 1982; Hamet & Merat, 1982; Johnson and Edgar, 1986 Bumstead & Millard, 1987; Ruff and Bacon, 1989; Albers &Verneigen, 1992). In agreement with the present observation, Pan and-van der laan, *et al,* (1998), in their experiment on the genetic resistance of different outbred lines of chickens against coccidiosis, showed that White Leghorn and its outbred lines are the most susceptible to the infection by coccidiosis compared to breeds like Fayoumi and Babcock. The amount of faecal oocystes excretion was highly correlated ($r=0.8$) with mortality rate of the infection suggesting that, compared to the rest breeds, White leghorn contributed more to the environmental contamination by oocystes and suffers from consequent mortality and chance of repeated infections by lethal dose of the viable *Eimeria* oocystes. This may suggest the fast multiplication rate of the parasite and its consequent pathogenic effects in this breed. This opinion supports the work of Gordon & Jonson, (1982) who argued that the variation in the output of faecal oocystes could be associated with the degree of resistance against the rate of asexual and sexual reproductive phases of the parasite and the presence degree of infection. In agreement with this fact, Malcolm (1978) and Gordon and Jonson (1982) also explained that the rate of reproduction and consequent pathogenic effects could be influenced by genetic make up of the host. On the other hand, the relative resistance of local breed to the infection may be partly attributed to frequency of exposure to the infection by oocystes as this breed has been maintained in the farm for

longer time and it seems, therefore, that resistant population line has developed over time.

Age of chickens had influenced faecal oocystes output significantly ($P<0.001$) and was positively correlated ($r=0.5$) with mortality rate due to coccidiosis. The period during which the oocystes appeared in faeces and death commenced as well as the age marks at which these parameters attained the maximum level and started to decline then after were reported to vary among the three breeds. Nevertheless, a steady regressive relationship was observed between increasing age and the amount of faecal oocystes excretion and mortality rate. The highest count of faecal oocystes and mortality were reported between the age ranges of 6th to 10th weeks. This is comparable with the work of Jordan (1990) in which reported the highest oocystes count and mortality rate at around the age of 5th to 8th weeks and a negative relationship then after. Malcolm (1978) also reported that coccidiosis infection in chickens is usually common at around the age of 6th week. Our finding, however, disagrees with that of Gordon and Jordan (1982) who argued that age resistance is not considered to be an important factor in susceptibility of chickens to coccidiosis.

Several factors could influence the nature of course of coccidiosis infection among which, immunity (Soulsby, 1982; Jordan, 1990) and viability and survival of oocystes on the ground are the most important. Different researchers at different times had described the importance of immunity in coccidiosis (Soulsby, 1982; Jordan, 1990; Qureshi *et al,* 1998; Pinard-van der laan, et al 1998). In agreement with the present observation, Soulsby (1982) and Malcolm (1978) stated that birds could develop resistance against coccidiosis infection with increasing age because of gradual exposure to the oocystes. Further more, it was reported that immunity could be acquired following the infection, although resistance may vary depending on the species and the number of subsequent re-infections (Soulsby, 1982; Malcolm, 1978). This supports our work in that mortality rate had started declining
significantly at around the age of 7th week and no mortality was reported
14th week after. The role of parental immunity in protecting young birds from infection by coccidiosis should not be ruled out in this aspect.

In the present observation, oocystes excretion had continued through out the study period, though the amount gradually declined. This agrees with the observation made by Malcolm (1978) who reported that oocystes production

usually declines following maximum production and clinical manifestation of the infection, though few might continue to appear for as long as 7 months.

The fact that no oocystes were detected in samples collected at early age (1 to 2 weeks) could be attributed to the species and nature of life cycle of the parasite. Malcolm (1978) described that the appearance of new generation of *Eimeria* oocystes is relatively late in the life cycle, usually a week after ingestion of sporulated oocystes. This is because the time required for completion of one prepatent cycle is at least seven days. On the other hand, Jordan (1990) emphasizing the shortness of the prepatent period of the parasite and its high biotic potential, stated that the number of oocystes produced rises gradually and rapidly attaining high concentration with in short period of time. This supports our observation in that the oocystes count increased sharply from 2nd week and attained the highest concentration at around 6th week.

This study shows that keeping different breeds of birds with different age categories in the same house, a management being practiced in the farm would create a potential risk for establishment of epidemic coccidiosis. This is because different breeds have different rates and period of faecal oocystes excretion thus contributing to the difference in the level of contamination of the environment by viable oocystes. This can be particularly potential source of infection for new batch of chicken where in the farm prior and subsequent removal of litter and disinfection of the house is only occasionally practiced and feeding and watering troughs cleaned and changed. Such kind of management would assist the establishment of resistant and viable oocystes that can be readily transported in live birds, which some times remain carriers for long period of time and become sources of infection for others. It was, thus, recommended that rearing chickens of different age groups, widely separated from each other, plays a pivotal role in the prevention of transmission of coccidiosis.

Furthermore, in this study increasing resistance to coccidiosis was shown to be possible through genetic selection and that keeping local chickens can help reduce incidence of the infection, provided that appropriate management is practiced.

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