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Economic Impacts of Coccidiosis on Productivity and Survivability of Chicken in Ethiopia, a Review

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Abstract

One of the main diseases generating issues in the production of poultry is coccidiosis, which is caused by the Eimeria species. Those causing haemorrhagic disease are E. Brunetti, E. necatrix, and E. tenella which are considered pathogenic and E. acervuline, E. mitis, E, maxima, and E. praecox causing malabsorptive disease. It is extensively dispersed wherever chickens are produced, whether it is in small-scale or intensive farming systems. As a result, the disease decreases the productivity and survivability of chickens. The current review thus sought to offer fundamental understanding of how coccidiosis affects the productivity and viability of chicken in Ethiopia from an economic standpoint. In all farms in Ethiopia, coccidiosis is blamed for both direct and indirect losses cause profit losses in large and small farms of 8.4% and 11.86%, respectively. This loss includes both direct and indirect which occurred in chicken mortality, coccidiostat cost, reduced weight gains, reduced market values of infected birds, delayed off take rate and reduced egg production in layers. coccidiosis had all rounded impact on productivity and profitability of small-scale poultry farming whereby a total of 1375 Ethiopian birr/month/farm is lost due to chicken coccidiosis. So, anticoccidial medications are incorporated into the diet to reduce high levels of infection. Additionally, minimizing overcrowding and keeping chicks, feed, and water away from droppings do help to prevent the sickness. Good control and preventative strategies typically prevent losses.

Keywords: Chicken; Coccidiosis; Economic lose; Parasites; Eimeria

Introduction

The total population of chicken in Ethiopia is about 57 million in this report; poultry includes cocks, cockerels, pullets, laying hens, non-laying hens and chicks [1]. Of which, most of the poultry are lying hens (34.26 percent), followed by poultry are chicks (32.86 percent), Pullets are estimated to be about 6.47 million in the country. Cocks and cockerels are also estimated separately, and are 6.38 million and about 3.27 million, respectively. The others are non-laying hens that make up about 4.59 percent (2.61 million) of the total poultry population in the country. About breed, 78.85 percent, 12.02 percent, 9.11 and percent of the total poultry were reported to be indigenous, hybrid and exotic, respectively [1]. Chicken production in Ethiopia is categorized into backyard, small scale, and large scale, which is based on the objective of the producer, the type of inputs used, and the number and types of chickens kept [2]. The rural poultry sector constitutes about 99% of the total chicken population and is managed under the traditional village poultry production system [3]. The main objective of rearing chicken in all production systems is concerned with egg and meat production, for income generation and home consumption [3].

Despite the high number of chicken available in Ethiopia, their contribution to households and national income is still very low (2-3%) [4]. The annual growth rates in egg and meat output were estimated to be about 1.0% and 2.6% as compared to the sub-Saharan Africa countries, which are 5.7% and 6.8% respectively [5]. Higher prevalence of coccidiosis coupled with other factors like sub-optimal management, lack of supplementary feed, and low genetic potential, are the causes of getting less return value from chicken production and productivity in Ethiopia [2]. Coccidiosis is a common protozoan disease of domestic birds and other fowl, characterized by enteritis and bloody diarrhea [6] It is one of the most important diseases of poultry worldwide; the disease is caused by protozoa of the Phylum Apicomplexa, family Eimeriidae, which undergoes a direct life cycle with transmission

between hosts by ingestion of sporulated oocysts [6]. The most prevalent causative agents of coccidiosis among the coccidia species are sporulated oocysts of genus Eimeria that primarily invade the intestine and caecal pouches leading to enteritis and thickening of the intestinal wall [7]. The oocysts are usually passed through feces of infected chickens; undergoing the process of sporulation when conditions are favorable [7]. Coccidiosis can occur anywhere in the poultry farm of unsanitary conditions. It can also occur during any season of the year. However, it is found to be more prevalent in summer season probably when higher summer temperature and wet beddings favored rapid sporulation of the oocyst [8].

Coccidiosis is one of profit limiting diseases prevalent in poultry industry in Ethiopia and it has been a major cause of poor performance and loss of productivity and survival of chicken [9]. It leads to high economic loss due to mortality of chicken, reduction in productivity, culling, drug and vaccine costs for prevention and control purpose of coccidiosis [7]. Even if coccidiosis has high economic loss on chicken productivity and survival in Ethiopia, there are different control and prevention measures based on a combination of good management and the use of anticoccidial compounds in the feed or water. Litter should always be kept dry and special attention should be given to litter near water fronts or feeding troughs [10]. Therefore, the objective of this review has the following objectives: -

- Review on economic impacts of Coccidiosis on productivity and survivability of chicken in Ethiopia.
- Review of control and treatment measures of coccidiosis diseases in chicken production.

Poultry Coccidiosis

Coccidiosis is a protozoan disease caused by parasites of the genus Eimeria. Twelve Eimeria species have been described from cattle, 11 species from sheep, 9 from goats, and 7 from chickens [11]. Those causing hemorrhagic disease are *E. brunetti*, *E. necatrix*, and *E. tenella* which are considered as pathogenic and E. acervulina, *E. mitis*, *E, maxima*, and *E. praecox* causing malabsorptive disease [12]. It is a major disease in commercial poultry production in many countries [12]. The infectious process is rapid (4-7 days) and is characterized by parasite replication in host cells with extensive damage to the intestinal mucosa. Each species has a specific site of development in the small intestine (upper, middle, lower, rectum, and caeca). Poultry coccidia have a high capacity to reproduce within the host; this leads to a rapid increase to the high level of the parasite within the susceptible host and subsequently a high level of contamination of the environment [13].

Occurrence and Distribution (Epidemiology) of chicken Coccidiosis

Poultry coccidiosis is distributed worldwide, wherever poultry is kept [14]. Intensive methods used to produce farm and laboratory animals favor the production of Emeria and the usual well balance host-parasite relationship, which commonly occurs in animals kept under natural conditions [8]. Low level infections occur in animals in the wild, because the intake of sporulated infective oocyst is small [15]. Epidemiology of coccidiosis in chickens depends on three factors which include environmental and management-related risk factors, the virulence of the agent and the host risk factors. These factors are modulated by environmental changes that can substantially affect their dynamics and consequently influence transmission patterns of the disease. Birds reared on litter are always at risk [9]. The occurrence of poultry coccidiosis is dependent on both the species of Eimeria and the size of the infecting dose of oocysts. Poultry coccidia have a high capacity to reproduce within the host; this leads to a rapid increase to the high level of the parasite within the susceptible host and subsequently a high level of contamination of the environment [8]. Oocytes may remain in buildings from a previous batch of birds, and they may be carried by mechanical means, including equipment, clothing, insects, and other animals. Birds introduced to an infected building will quickly become infected [6]. Poor hygiene related to personnel, feeding, and drinking was important for the presence of Eimeria species and other diseases on the farm [6].

Life Cycle and Transmission of Chicken Coccidiosis

The life cycle of Emeria consists of two stages. An exogenous stage: sporogony in the external environment and an endogenous stage: in the digestive tract of the chicken [16]. In the Exogenous Stage: Infected birds excrete oocysts with their droppings in the external environment. The oocysts excreted in this way must sporulate to become infectious. Sporulation or sporogony is therefore an important stage in the parasitic cycle. It takes place outside the host in external environments. About 48 hours at 25-28°C, or longer if the temperature is lower, are needed for the sporont inside the oocyst to transform itself into four sporocysts each containing two sporozoites [17]. Endogenous Stage: Ingestion of sporulated oocysts and excystation: the chicken becomes infected by ingestion sporulated oocysts present in the environment: litter, feed and water contaminated by feces of oocyst excreting chickens [17]. Coccidia populations take time to build dangerous levels, therefore, outbreaks usually occur when birds are between 3 and 8 weeks of age [8]. Young chickens (under six months of age) are most susceptible to the disease since they haven ‘t had time to develop natural immunity. However, adult chickens can also be infected with the disease and pass it on to other members of the flock through their droppings [18]. Maximum prevalence of coccidiosis in chicken was reported during 41-50 days of age [19]. Infection is via the fecal-oral route. Under the right environmental conditions, the oocysts can contaminate all areas of the chicken ‘s environment, including feed, litter, soil, and be viable for months [19]. Consequently, controlling substrate and litter moisture levels become essential. Oocysts can be transmitted by mechanical carriers (e.g., equipment, clothing,

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insects, farmworkers, and other animals. Wet litter may have a strong ammonia smell which can cause coccidial overgrowth and other flock management problems [20].

Clinical Signs of Chicken Coccidiosis

Sign of coccidiosis in chicken include diarrhea, fever, inappetence, weight loss, emaciation, and in extreme cases, death. The birds become depressed, have ruffled feathers, the wings droop, have diarrhea, and tend to huddle [19]. Food and water consumption usually decreases and may become emaciated and dehydrated. Laying hens will experience a reduction in the rate of egg production. Cecal coccidiosis may produce bloody droppings and clinical signs are associated with tissue destruction from the release of the merozoites and mature oocysts from the mucosal surface during the last generations of merogony and throughout gametogony [13].

Diagnosis of Chicken Coccidiosis

Diagnosis of coccidiosis is usually based on post-mortem lesions and fecal examination for oocysts when damage has already occurred [21]. The severity of lesions, as well as knowledge of flock appearance, morbidity, daily mortality, feed intake, growth rate, and rate of lay is important for diagnosis. The diagnosis of coccidiosis in chicken is best accomplished by postmortem examination of the representative number of chickens [22]. The location in the host intestine, the appearance of lesions, and the size of oocysts are used in determining the species present [10]. Some symptoms of coccidiosis need differential diagnosis when Intestinal coccidiosis may be confused with necrotic enteritis, haemorrhagic enteritis, or other enteric diseases. Caecal coccidiosis may be confused with histomoniasis and salmonellosis due to their similar lesions. Infections with salmonella pullorum usually cause very high mortality in young chickens and turkeys within the first 2-3 weeks of age. Chickens may die in the hatchery shortly after hatching. Affected birds huddle near a heat source, are anorectic, appear weak, and have whitish diarrhoea around the vent and in postmortem examination enteritis of anterior small intestine which confuse with coccidiosis and poultry cannibalism is confusing to diagnose poultry coccidiosis due to blood on cloaca. Identification of different species based on the morphology of oocysts is very challenging and requires expertise. Poultry coccidiosis is diagnosed by different methods like Coprological Examination, Post-mortem Examinations and Molecular tests.

Coprological Examination

The most popular parasitological examination approach for diagnosing chicken coccidiosis is the coprological examination. It is a qualitative technique for detecting the oocyst by precisely conducting the procedure [23]. The first step is to collect 3-5g of feces from the upper surface of the litter immediately after birds have dropped, dissolve the feces in 20-30 ml of flotation solution (NaCl), then sift the fecal suspension through a tea strainer into a beaker. The sample should next be centrifuged for 3-5 minutes at 1500 rpm. Finally, look at it under a microscope with low power objectives [23].

Postmortem Examinations

The intestines may be enlarged, with necrotic and/or hemorrhagic foci, undigested food, and gas [6]. Eimeria species was determined by the type and location of lesions in the gut [20]. Eimeria acervulina affects the upper regions of the small intestine; little red spots and white bands may appear; E. maxima affects the entire small intestine; the intestine appears wet and has blood and mucus in later stages. With red pinpoint lesions, the gut may appear swollen and inflated. Eimeria tenella affects the gut's blind sacks (ceca) [24] (Table 1) [25].

Table 1: Different species of Eimeria and their pathogenicity in chicken. Source: [25].

Eimeria species	Oocyst size	Host species	Site of infection	Pathogenicity
E. acervulina	18 x 14µm	Chickens	anterior small intestine	High
E. brunetti	26 x 22µm	Chickens	small and large intestines	High
E. maxima	30 x 20µm	Chickens	mid small intestine	Moderate
E. mitis	16 x 15µm	Chickens	small and large intestines	Low
E. necatrix	20 x 17µm	Chickens	small intestine, caecum	High
E. praecox	21 x 17µm	Chickens	small intestine	Low
E. tenella	23 x 19µm	Chickens	Caecum	High

Control and Prevention of Chicken Coccidiosis

Prevention and control of avian coccidiosis is based on a combination of good management and the use of anticoccidial compounds in the feed or water. Litter should always be kept dry and special attention should be given to litter near water fronts or feeding troughs [26]. In the large-scale industry, drugs are used for prevention rather than treatment. If you treat birds after an outbreak, prevention may not be effective. Out breaks of coccidiosis treated with different drugs via the drinking water and feed (Table 2) [27]. To prevent and control chicken coccidiosis different approaches should be taken like, vaccination; litter management and house hygiene; provide adequate space and ventilation; quarantine new members of the flock; good biosecurity and use different c and curative treatment [28]. Avoid sharing equipment

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with different poultry that have been used for other activities or on a neighboring poultry farm. Coccidial oocysts are normally brought in through contaminated equipment. Full immunity is not reached in chickens until approximately seven weeks of age. To keep from spreading infection yourself, it is essential to wash the hands of the caretaker always after working with poultry [29].

Table 2: Drugs for Treatment of Coccidiosis in Chickens. Source: [27].

List of drugs	Dose (in % of body weight)	Feed or Water
Amprolium	0.012%-0.024%	Water
Chlortetracycline	0.022% + 0.8%	Feed
Oxytetracycline	0.18%-0.55%	Feed
Sodium sulfachloropyrazine monohydrate	0.03%	Water
Sulfadimethoxine	0.05%	Water
Sulfamethazine (sulfadimidine)	0.10%	Water
Sulfaquinoxaline	0.10%	Feed
Furazolidone	0.18%-0.55%	Feed

Economic Impact and prevalence of Chicken Coccidiosis in Ethiopia

Poultry coccidiosis seriously impairs the growth and feed utilization of infected birds resulting in loss of productivity and survival of chickens [30]. An outbreak of coccidiosis has a very high negative and economic impact on the flock as well as for the poultry producer as treatment alone cannot prevent economic losses. In Ethiopia, a study was conducted in small and large poultry farms in Debre Zeit, showed that coccidiosis contributes to 8.4% and 11.86% losses in profit in large and small-scale farms, respectively losses due to mortality; Coccidiostats cost and Culling [31]. In Gondar town Amhara regional state, a study conducted on the Prevalence of poultry coccidiosis and associated risk factors in intensive farming system report showed that poultry coccidiosis is an important health problem of chickens in the study area with overall prevalence of 42.2% the prevalence of coccidiosis was relatively higher in younger age (51%) than adults (36.7%) [10]. Another report in kombolcha town, northern parts of Ethiopia showed that, the lowest coccidiosis case were recorded in the age of 21-30 days (10.3%) and the highest number of cases of coccidiosis (73.1%) were recorded at the age of 51-60 days [32]. Sick chickens show depression; bloody diarrhea; mucoid dropping and loss of production with 5% mortality rate and 17.5% of prevalence of clinical coccidiosis in tigray region of selected small scale poultry farm and coccidiosis had all rounded impact on productivity and profitability of small-scale poultry farming whereby a total of 1375 Ethiopian birrr/month/farm is lost due to chicken coccidiosis [33]. This loss includes both direct and indirect which occurred in chicken mortality, coccidiostat cost, reduced weight gains, reduced market values of infected birds, delayed off take rate and reduced egg production in layers [32,33].

According to [34], research conducted on prevalence and risk factors of coccidiosis in poultry farms in and around Ambo Town, Western Ethiopia, result shows that, out of the total 384 chicken examined, 79 (20.57%) were positive for coccidian parasites. The prevalence was significantly higher in Bovans (25.10%) than local breeds (12.41%) of chickens. Prevalence of poultry coccidiosis in and around Yabello, southern Ethiopia the highest prevalence rate (22.1%) in chicken reared in intensive management system and the lowest prevalence rate (16.7%) in extensive management system [35]. A study conducted on the prevalence of poultry coccidiosis in intensive farm and individual small holder poultry farm in hawassa town district from the total of 384 examined for the presence of eimeria oocysts, 250(65.10%) chickens are found to be positive for eimeria oocysts and 134 (34.9%) were found to be negative for eimeria oocysts. out of 250 positive Chickens 154(61.6%) were in intensive management system and 96(38.4%) in extensive or back yard poultry farm [36]. In Jimma Town southwest parts of Ethiopia, Prevalence was slightly higher in exotic breed (36.4%) than indigenous breed (23.7%) association is significant with breed and Higher infection rate were detected in young (48.8 %) than Adults (30.2%). Age and risk of coccidial infection were significantly associated [37].

Conclusions

Coccidiosis is a protozoan disease caused by parasites of the genus Eimeria. Seven Eimeria species have been described from chickens. It is distributed worldwide, wherever poultry is kept. Poultry coccidia have a high capacity to reproduce within the host; this leads to a rapid increase to the high level of the parasite within the susceptible host and subsequently a high level of contamination of the environment. The disease transmits though feed, litter, soil, equipment, clothing, insects, farmworkers etc. the infected chicken has a Sign of diarrhea, fever, inappetence, weight loss, emaciation, and in extreme cases, death. So, it results in loss of productivity and survival of chickens. This loss includes both direct and indirect which occurred in chicken mortality,

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coccidiostat cost, reduced weight gains, reduced market values of infected birds, delayed off take rate and reduced egg production in layers. Then to prevent such types of lose different approaches should be taken like, vaccination; litter management and house hygiene; provide adequate space and ventilation; quarantine new members of the flock; good biosecurity and use different curative anti coccidia treatment.

Recommendations

Based on the above conclusions the following recommendations should be forwarded: -

➢ The stockholder of government, NGOs and other responsible bodies should be creating awareness about prevention and control measures of chicken coccidiosis for poultry farm owners.

Using an all-in, all-out approach and avoiding rearing together different age groups of hens.

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