American Journal of Animal and Veterinary Sciences

Original Research Paper

Assessment of Chili Pepper (*Capsicum annuum*) as an Additive for the Prevention of Coccidiosis

Jenny Piedad Lozada-Ortiz, Oscar Patricio Núñez-Torres and Jorge Ricardo Guerrero-López

Facultad de Ciencias Agropecuarias, Carrera de Medicina Veterinaria, Universidad Técnica de Ambato, Ecuador

Article history
Received: 29-09-2021
Revised: 24-01-2022
Accepted: 10-03-2022

CorrespondingAuthor:
Jenny Piedad Lozada-Ortiz
Facultad de Ciencias Agropecuarias, Carrera de Medicina Veterinaria, Universidad Técnica de Ambato, Ecuador
Email: jpia0405@hotmail.com

Abstract: Nowadays, the use of plants is an alternative for the control and treatment of diseases in the poultry industry. The objective of this study was to evaluate the effect of chili pepper (*Capsicum annuum*) as a natural additive for the prevention of coccidiosis in broilers up to 8 weeks of age. For this experiment were used 288 Ross 308 chickens of one day distributed in 4 treatments, 6 repetitions and 12 animals in each group, where the treatment was applied (T1 0.1; T2 0.2; T3 0.3; T0 0%) Chili pepper. A Completely Randomized Design (CRD) was carried out, with an analysis of variance and the Tukey 5% test for the treatments, the variables oocyst count per gram of faeces and various productive parameters were evaluated, Finally, it was demonstrated that the best dose of natural coccidiostat with the best performance both in weight gain and feed conversion was with the dose of 0.3% of chili peper, in addition, with this percentage the amount of *Eimeria* oocytes was reduced, preserving the intestinal health of the animals. This study contributes to have a better production alternative and competitiveness in the face of the new demands of chicken consumption in the market.

Keywords: Broilers, Coccidiosis, *Capsicum Annuum*, *Eimeria* Oocytes.

Introduction

Coccidiosis is a parasitic disease produced by a protozoan of the genus *Eimeria* of between 15 and 30 microns, it affects several domestic species but particularly three-week-old chickens, depending on the *Eimeria spp*, have different degrees of pathogenicity, as they have a predilection for invading the epithelial cells of the small intestine, the cecum and large intestine, causing enteritis and preventing the absorption of nutrients and reducing feed conversion (Quiroz-Castañeda and Dantán-González, 2015). Currently 7 different species of coccidia are described in chickens: *E. Tenella, E. acervulina, E. Maxima, E. necatrix, E. brunetti, E. imitis and E. praecox.* (Gordon and Jordan, 1985).

The life cycle of coccidia can last from 4 to 7 days depending on the species. Coccidia under conditions of humidity, oxygen and adequate temperature, cause 4 spores to develop within the oocyst that contain two sporozoites each (Leitch and He, 2012). The oocyst, when ingested by the animal, undergoes the action of gastric acid and the mechanical action of the gizzard causing the release of the 8 sporozoites, which penetrate the epithelial cells of the small intestine, where the trophozoites divide into two nuclei. These nuclei continue dividing until they form hundreds of trophozoites, then merozoites are generated and by asexual reproduction give rise to oocysts that are excreted in faeces (Escobar *et al*., 2010).

Sick animals tend to cluster and isolate themselves in small groups, their feathers are rough and dirty, they eat less or even no longer eat and they drink very little water. More than 100,000 oocytes/g of stool have a clear diagnostic value, a very low quantity of less than 10,000 oocytes/g of stool does not require treatment (Johnson and Reid, 1970). Second-generation coccidia cause severe tissue damage, bleeding and often complete destruction of the mucosa and muscle layer (Gazoni *et al*., 2020).

Mixed infections are common in broilers, this is attributed to poor management of the sheds, since there is a higher prevalence in small and medium-sized farms, *E. tenella* is one of the most pathogenic *Eimeria species*, causing high mortality in birds and its prevalence in young backyard chickens is 80%, where overcrowding and high humidity increase its presence on farms. This disease is characterized by the manifestations of macroscopic and microscopic lesions, located according to the type of *Eimeria*, where the birds show the typical signs such as bloody feces, causing damage to the intestinal mucosa, weakening its integrity and predisposing to necrotic enteritis (Espinoza, 2019).

The use of plant extracts such as Capsaicin has bactericidal and bacteriostatic effects, promote effectively defense mechanisms against microbial infections and oxidative stress. In addition, improved feed intake and digestive juice secretion, antibacterial, anthelmintic, even antiviral effects, retaining effect adjuvant in viral vaccinations (Lillehoj *et al*., 2018). Currently, multiple poultry farms are pursuing coccidiosis control programs with vaccines, ionophore and chemical anticoccidial agents on a rotational basis to control increased resistance to specific parasitic strains. For this reason, several researches are based on the search for alternatives that can replace antimicrobial chemicals by plant extracts, chili pepper *(Capsicum annuum)* has been described as a natural Antimicrobial used as a Growth Promoter (AGP), it has been determined that its use has a positive effect on body weight, weight gain, feed conversion and productive efficiency index, recently it was described that it improves meat quality characteristics. (Oñate *et al*., 2018) (Nacimento *et al*., 2020) (Tashla *et al*., 2020).

Therefore, the aim of this study was to evaluate the productive parameters in broilers related to the inclusion of chili pepper (*Capsicum annuum*) as a natural additive for the prevention of coccidiosis in broiler chickens.

Materials and Methods

The present study is experimental. The test was carried out in the Tungurahua Province, in the city of Ambato, Augusto N. Martinez parish, with climatological characteristics of average temperature 12°-21°C, relative humidity 60%, luminosity 12 hours/day, altitude 2800 msnm, longitude w78° 37'11", The vaccination protocol was: The first day: Infectious bronchitis H120, at 7 days: Gumboro vaccine (Intermediate), Newcastle (La Sota), at 15 days: Gumboro vaccine (Bursine II) and at 21 days: Mixed vaccine (Bronchitis) H120 + Newcastle La Sota).

A total of 288 onde-day-old Ross 308 chicks were used for this study, the weights were recorded, to supply the chili, it was dried and ground first a month before, it was used as a natural coccidiostat in a period of eight weeks, the experiment was carried out on a ship 10 animals/m^2, the chickens were randomly distributed in 24 units experimental with a number of 12 animals per treatment**.** Study factors: T0 0%, T1 0.1%, T2 0.2%, T3 0.3% chili powder. For this trial, a Completely Randomized Design (CRD) was used, with 4 treatments and 6 repetitions, which gives us a total of 24 experimental units. Subsequently, for the management of the research, the chili pepper (*Capsicum annuum*) was dehydrated naturally for 21 days at temperatures of 21 to 24°C, until reaching a complete desiccation; then the flour was obtained with the help of an electric mill. The flour was added to the commercial feed of the animals, during the experiment, chicks watered *ad libitum.*

To then perform a proximal analysis of the chili pepper and quantify the capsaicin by colimetric methods of analisis Snell and Snell 0.122 mg/100 g (LABOLAB). The doses of chili flour as a growth promoters are similar to those studied by Puvača *et al*. (2015). Recently, the levels of 0.5 (CP-0.5) and 1.0% (CP-1.0) chili in broiler diets have been studied for their influence on productive performance and health parameters (Marić *et al*., 2021). For the evaluation of coccidial control, stool samples were taken from the animals from the third week to perform coproparasitic tests in the laboratory of IncubadoraAndinasa; weekly samples were taken until the animals were slaughtered. To establish the concentration of total oocysts of *Eimeria*, flotation techniques were used, then the sample was placed in neubauer chamber and allowed to stand for 2 min. Finally, the total number of oocysts was summed, the result was the number of oocysts per gram of faeces from the fecal material.

Results and Discussion

The data in Table 1 show body weight gain and feed conversion ratio and highly significant differences between treatments with respect to the percentage of natural coccidiostat included in the diet versus the control. The coefficient of variation is 5.54%. For the variable weight gain in the initial stage, three ranges of significance are registered; being the best T3 (0.3% chili flour) with an average of 370.0 g, followed by T2 (0.2% chili flour) with 349.67 g, then T1 (0.1% of chili flour) with 312.7g, the last range of significance was occupied by T0 (control) registering weights of 280.83g, in the initial stage diet, coinciding with the growth and fattening stages that the best treatments were T3 (0.3% chili flour) with 1325g and 1621.67g respectively. A study showed that the inclusion of chili at 0.5, 0.75 and 1% levels in broiler diets of the Ross 308 hybrid line improved body weight gain and feed conversion ratio (Marić *et al*., 2021). On the other hand, Zhang *et al*. (2005), affirmed the use of capsaicin as a growth promoter.

From the results presented in Table 2, the values of the coprological analysis performed at 36, 45 and 54 days can be observed. The highest values of Oocytes Per Gram of faeces (OPGH) were found in the control treatment, followed by T1(0.1% of chili flour) and T2 (0.2% of chili flour), finally the lowest values of OPGH were observed in T3 (0.3% of chili flour), which means that the use of a natural coccidiostat based on chili flour in the feeding diet improves immunity and reduces the values of oocytes per gram of faeces. Johnson and Reid (1970), established that a high number of more than 100,000 oocytes/g has a clear diagnostic value. Very low numbers of less than 10,000 oocytes/g do not require treatment. In a previous study, oocyst counts were similar to our present study (Mora *et al*., 2011).

Figure 1 shows the percentage of mortality for each of the treatments, these results indicate a high percentage of mortality in the group of animals that did not receive natural coccidiostat in the diet, the experiment ended with a total of 244 animals. The lowest mortality percentages were observed in the animals that received 0.3% chile flour. I agree with Nacimiento (2020) who indicated that the inclusion of chili oleoresins could substitute chemotherapeutic antimicrobials, thus improving the Productive Efficiency Index. Our study has shown that the addition of chili as a AGP has a positive effect on the prevention of coccidia in chickens, which is also consistent with previous findings (Oñate *et al*., 2018).

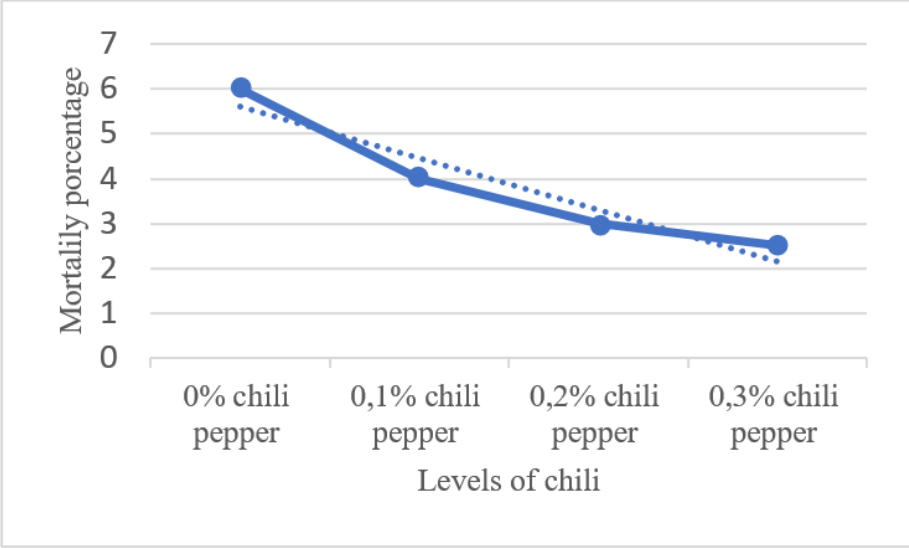

Fig. 1: Mortality percentages

Table 1: Summary of the productive indices accumulated in starting, growing and fattening stages

Evaluate Indices	Levels of (*Capsicum annuum*) 0.1%	0.2%	0.3%	0%	C.V %
STARTTING STAGE					
G.P	313.00	350.00	370.00	370.00	28.43**
C.A	1.40	1.20	1.20	1.50	22.00**
R.S.G.P	312.7^{b}	349.67^{a}	370.0^{a}	280.83^{c}	
R.S.C.A	2.02^{a}	2.13^{a}	2.32^{b}	2.50^{c}	
GROWING STAGE					
G.P	1189.00	1270.00	1211.00	538.00	36.16*
C.A	2.00	1.90	1.70	2.20	29.58**
R.S.G.P	1189.33^{b}	1270.17^{b}	1395^{a}	1087.50^{c}	
R.S.C.A	2.02^{a}	2.13^{a}	2.32^{b}	2.50^{c}	
FATTENING STAGE					
G.P	1448.00	1602.00	1622.00	1314.000	20.23**
C.A	2.60	2.40	2.40	2.700	9.87*
R.S.G.P	1448.3^{b}	1601.6^{a}	1621.6^{a}	1314.0^{c}	
R.S.C.A	2.35^{a}	2.38^{a}	2.63^{b}	2.67^{b}	

Table 2: *Eimeria* oocyte count expressed in gram per faeces

T	36 days (oocyte/g)	45 days(oocyte/g)	54 days (oocyte/g)
T3	14583	14583	25000
T2	20833	31167	25000
T1	20833	34167	50000
T0	45833	81250	104667

Conclusion

Capsicum annuum ia as a natural antimicrobial used as a growth promoter AGP in broiler, has a positive effect in productive parameters and reduces coccidiosis infections. These results could be an alternative for backyard poultry and organic production.

Acknowledgement

We thank Juan Andrade and Ana Lucia Morales for providing us with the facilities of her farm for the development this study . The autors would like to thank Incubandina S.A for their technical assistance.

Author's Contributions

Jenny Piedad Lozada-Ortiz: Material, preparation, data collection and analysis, wrote the manuscript.

Oscar Patricio Núñez-Torres: Wrote the first draft of the manuscript.

Jorge Ricardo Guerrero-López: Disigned the overall experiment, participated in all experiment, performed the data analysis

Ethics

This article is original and contains unpublished material. The corresponding author confirms that all of the other authors have read and approved the manuscript and no ethical issues involved.

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