

Growth performance parameters in chicken experimental coccidiosis treated with Diclazuril and Clopidol: The need for assessing new anticoccidial resources

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Abstract:

BACKGROUND: Coccidiosis is recognized as the parasitic disease that has the greatest economic impact on poultry production. Modern poultry production is largely dependent upon anticoccidials. **OBJECTIVES:** The aim of the present study was to determine and compare the efficacy of two chemical anticoccidials (Clopidol and Diclazuril) on oocyst shedding and their probable effects on growth performance and feed efficiency of broilers in experimental coccidiosis. **METHODS:** One hundred and twenty Ross 308 one day old broilers were randomly assigned into 4 groups: CON+, infected with Eimeria mixed oocysts but not medicated; CON-, not infected and not medicated; CLO, infected and medicated with Clopidol; DIC, infected and medicated with Diclazuril. Chickens in all groups except negative control were inoculated by mixed sporulated oocysts of pathogenic Eimeria at the end of the 3rd week of age. Oocyst shedding was counted using a Mc Master counting chamber. Body weights, body weight gains, and feed conversion ratio were determined on weekly basis. **RESULTS:** Obtained results showed that Diclazuril was more effective in reducing oocyst shedding than Clopidol. As expected, mean body weight in the positive control group was lower than other groups. But surprisingly, no significant difference was found between Diclazuril or Clopidol treated birds and positive control group, at the end of the experiment. In comparison of weight gain in different treatment groups except for the 4 and 5th week, no significant difference was found in different groups. In the last week of the experiment, difference in weight gain between groups was not significant. According to feed conversion ratio (FCR) results, anticoccidial supplementation did not have any significant effect on improving FCR. **CONCLUSIONS:** It is reported that some anticoccidials reduce feed consumption and feed conversion. It seems that neither of the present synthetic anticoccidials is completely satisfactory in controlling coccidiosis economic losses and new strategies are urgently required.

Introduction

Amongst various parasitic infections, coccidiosis caused by obligate intracellular protozoan parasite of the genus *Eimeria*, is a major parasitic disease within the intensively reared poultry industry. *Eimeria* spp. are highly host-specific, with six species having economic impact on chicken (Arabkhazaeli et al., 2013). The annual worldwide cost is estimated at about \$800 million (Allen and Fetterer, 2002). These estimates include the costs of prophylactic in-feed medication for broilers and broiler breeders, alternative treatments if medication fails and losses due to mortality, morbidity, impaired growth rate, temporary reduction of egg production in layers and poor feed conversion of chickens that survive outbreaks (Pirali-kheirabadi et al., 2008). It has been shown that coccidiosis also causes great economic losses in the poultry industry of Iran (Rahbari et al., 1995). For many years, prophylactic use of anticoccidial drugs has been the primary means of controlling chicken coccidiosis in broiler industry and has played a major role in the growth of this industry. Modern intensive poultry production is largely dependent upon chemoprophylaxis for the control of coccidiosis (Allen and Fetterer, 2002). The effective use of anticoccidial feed additives over the past 50 years has played a major role in the growth of the poultry industry and has allowed the increased availability of high quality, affordable poultry products to the consumer. These anticoccidials can be classified as (i) chemicals which have specific modes of action against parasite metabolism, such as amprolium, clopidol, decoquinate, halofuginone, or (ii) polyether ionophores such as monensin, lasalocid, salinomycin, narasin, and maduramycin, which act through general mechanisms of altering ion transport and disrupting osmotic balance (Mathis, 2001). The aim of this study was to determine and compare the efficacy of two chemical anticoccidials (Clopidol and

Diclazuril) on oocyst shedding and their probable effects on growth performance and feed efficiency of broiler chickens in experimental coccidiosis.

Materials and Methods

In this study, 120 Ross 308 one day old broilers were randomly assigned into 4 treatment groups, containing 30 in each treatment. Each contained 3 replicates of 10 chicks. Each replicate were allocated in separate pens in similar condition. During the experiment, all groups were fed on a basal diet, food and water were provided ad libitum. The basal diets were in mash form and formulated for starter (1-14 d), grower (15-29 d), and finisher (30-42 d) growth periods, the composition is shown in Table 1. The temperature was 29-30°C in the first day and was reduced by 5°C on every 3 days basis, maintained at 21-22°C from day 30 to the end of the experiment. Lighting was provided for 24 h throughout the first week and from day 8 to the end of experimental period, lighting was provided for 23 h. Humidity level was adjusted at 60-70% during the experiment. Chickens in all groups were inoculated orally by 0.5 ml mixture of sporulated oocyst of four pathogenic species of *Eimeria* (3×10^4 *E. tenella*, 3×10^4 *E. necatrix*, 4×10^4 *E. maxima*, and 105 *E. acervulina*) at the end of the 3rd week of age.

Treatment group 1 was assigned as positive control group infected but not medicated (CON+), group 2 was negative control, not infected and not medicated (CON-). Treatments 3 (CLO) and 4 (DIC) were infected and medicated with Clopidol 500g/ton and Diclazuril 250g/ton, respectively. Oocyst shedding was counted according to the method described by Pirali-kheirabadi et al. (2008) and using a Mc Master counting chamber from days 5 to 11 post challenge. Body weights (BW), body weight gains (BWG), and feed conversion ratio (FCR) were determined on weekly basis

Table 1. composition of starter, grower and finisher diets in experimental design.

Ingredients (%)	Starter(1-21d)	Grower(21-28d)	Finisher(29-42d)
Corn	57.60	58	60
Soybean meal	35.00	34.5	32.3
Soybean oil	2.5	2.66	3.2
Vitamin A premix	0.2	0.2	0.2
Vitamin E premix	0.2	0.2	0.2
Vitamin K premix	0.1	0.1	0.1
Vitamin D premix	0.1	0.1	0.1
Oyster shell	1.04	1.04	1
Dicalcium phosphate	1.9	1.8	1.7
NaHCO ₃	0.13	0.13	0.13
Salt	0.26	0.26	0.26
Vitamin mixture	0.25	0.25	0.25
Mineral mixture	0.25	0.25	0.25
Methionine	0.13	0.15	0.1
Lysine	0.1	0.1	0.1
Choline	0.1	0.1	0.1
Calculated chemical composition			
ME (kcal/kg)	3.01	3.03	3.08
Crude protein(%)	20.47	20.29	19.39

in all groups. All data were compared using one way ANOVA, differences between means were considered significant at $p < 0.05$. All data were presented as mean \pm SEM.

Results

Oocyst shedding: The numbers of oocyst per gram (OPG) of feces samples for all groups of chickens are shown in Fig. 1. Coccidian oocyst count obtained from feces samples during post challenge days showed that the birds in positive control group shed maximum number of 266×10^3 oocysts, seven days post inoculation. The birds infected with *Eimeria* and fed diets supplemented with Clopidol or Diclazuril shed almost 144×10^3 and 110×10^3 oocysts, respectively in 7 days post infection. There was significant decrease in OPG in the infected/medicated groups in days 7, 8, 9 and 10 as compared to infected/not medicated positive control group ($p < 0.05$). There was also significant decrease of OPG in the group that received Diclazuril in days 9 and 10 in comparison to Clopidol receiving group ($p < 0.05$) (Fig.

1). Diclazuril was more efficient in reducing oocyst shedding.

Growth performance: Mean body weight: Significant difference in mean body weight was seen between negative control and positive control groups from the 4th week to the end of the experiment (6th week) ($p < 0.05$). Surprisingly, no significant difference was seen at the end of the experiment between diclazuril and clopidol treated groups and positive control group ($p > 0.05$) (Table 2).

Body weight gain: The lowest body weight gain in the 4th and 5th week was related to positive control group. According to statistical analysis, in the 4th week of the experiment, there was significant differences between positive control group and Diclazuril treated group in comparison to negative control and Clopidol receiving group ($p < 0.05$). In the last week of the experiment, no significant difference was seen when comparing different groups ($p > 0.05$) (Table 3).

Food conversion ratio: The highest FCR post challenge was related to the positive con-

Table 2. Effect of clopidol and diclazuril on mean body weight in broiler growth performance in experimental coccidiosis. CON+, as positive control, infected but not medicated; CON-, as negative control, not infected and not medicated; CLO, infected and medicated with Clopidol; DIC, infected and medicated with Diclazuril. Different letters in columns indicate significant differences between treatments (based on $p < 0.05$).

Weeks of age Mean Body Weight	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
CON+	107.8±1.73	332.6±31.24	680.2±11.46	966.9±20.49 ^a	1356.6±17.6 ^a	1863.35±15.86 ^a
CON-	107.5±1.44	350.3±12.41	702.2±10.99	1121.9±2.02 ^b	1647.2±10.39 ^b	2103.5±10.69 ^b
CLO	107.4±1.44	332.6±8.98	664.7±10.84	976.9±11.82 ^a	1433.9±32.86 ^a	1915.3±3.09 ^a
DIC	107.5±0.76	329.2±11.54	690.7±23.57	1084.6±31.86 ^b	1556.5±24.61 ^b	1961.5±9.01 ^a

Table 3. Effect of clopidol and diclazuril on body weight gain (BWG) in broiler growth performance in experimental coccidiosis. CON+, as positive control, infected but not medicated; CON-, as negative control, not infected and not medicated; CLO, infected and medicated with Clopidol; DIC, infected and medicated with Diclazuril. Different letters in columns indicate significant differences between treatments (based on $p < 0.05$).

Weeks of age BWG	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
CON+	65.3±2.01	224.8±12.17	347.56±11.7	286.7±17.5a	389.73±5.78a	506.86±2.21
CON-	66.5±0.3	244.3±13.21	351.9±3.19	419.63±10.95b	515.3±8.39 b	456.3±1.21
CLO	64.8±1.3	221.83±11.58	335.5±10.84	312.2±10.14a	456.96±23.58	464.7±40.88
DIC	65.5±0.98	221.7±11.51	368.13±6.57	393.9±11.77b	417.93±11.54	404.96±16.43

Table 4. Effect of clopidol and diclazuril on food conversion ratio (FCR) in broiler growth performance in experimental coccidiosis. CON+, as positive control, infected but not medicated; CON-, as negative control, not infected and not medicated; CLO, infected and medicated with Clopidol; DIC, infected and medicated with Diclazuril. Different letters in columns indicate significant differences between treatments (based on $p < 0.05$).

Weeks of age FCR	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
CON+	2.55	2.43	2.64 ^a	1.65	1.28	1.2
CON-	2.46	2.26	2.15 ^b	1.6	1.25	1
CLO	2.33	2.29	2.21 ^b	1.62	1.24	1.01
DIC	2.39	2.28	2.23 ^b	1.58	1.23	0.99

control group in the 3rd week of the experiment, which was statistically significant in comparison to other groups ($p < 0.05$). In the last 3 weeks of the experiment, FCR in the positive control group was higher than other groups but it was not statistically significant ($p > 0.05$). Anticoccidial supplementation did not have any significant effect on FCR (Table 4).

Discussion

Coccidiosis is a widely occurring protozoan parasitic disease and is the most expensive disease facing the poultry industry. Coccidiosis causes a tremendous expense in terms of both prevention and loss of performance (Mathis,

2001). In the field of poultry coccidiosis, a sharp distinction is often made between chemical and ionophore anticoccidials. Chemical anticoccidials are typically characterized by a complete block of coccidial multiplication, which is in contrast to ionophore anticoccidials which always allow for a limited multiplication known as coccidial leakage (Vancraeynest et al., 2008). As both Diclazuril and Clopidol are chemical anticoccidials, it is expected that they should be equally effective at blocking the multiplication of coccidia. However, in the present study, OPG in the Diclazuril treated group was significantly lower than in the Clopidol group ($p < 0.05$). This is in line with the findings of Pirali-kheirabadi et al. (2008)

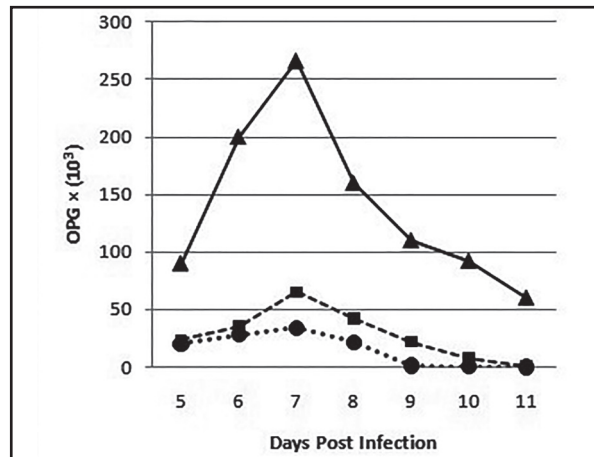


Figure 1. Numbers of oocyst per gram (OPG) in feces samples of experimental groups. CON+ —▲— CLO —■— DIC ●●●

who reported that comparing anticoccidial effect of Salinomycin and Diclazuril indicated that Diclazuril was significantly more effective on oocyst shedding and was highly effective against combined infection of *Eimeria* spp. Conway et al. (2001) demonstrated that the use of 1 ppm diclazuril in shuttle programs was highly efficacious against a mixed inoculum of *Eimeria* spp. Peeters et al. (1994) reported that chemical drugs showed the highest activity against *Eimeria*, whereas ionophores were less efficacious. They also demonstrated that the highest activity against *E. acervulina* was obtained with Clopidol and the highest activity against *E. maxima* was obtained with Diclazuril. Bird performance, particularly weight gain is widely used for assessing anticoccidial efficiency (Arabkhazaeli et al., 2013). In this study, supplementing diet with Clopidol and/or Diclazuril had positive effect on mean body weight, weight gain and FCR of infected groups only in the 4th week of the experiment. However, Clopidol and Diclazuril were effective in reducing oocyst shedding but, they did not have any significant effect on weight gain, mean body weight and FCR in the last 2 week of the experiment. In line with the results obtained in this study, Bahadoran et al. (2014) used two anticoccidial drugs, Clopidol and Amprolium + Ethopabate as protection in the diets of healthy chickens for 3 weeks and

reported their adverse effects on the bird performance i.e. body weight and feed conversion rate. Abbas et al. (2009) showed that in *Eimeria* inoculated chickens, the FCR values of Diclazuril medicated groups were numerically lower compared with infected non-medicated groups but it was statistically insignificant. On the other hand, Pirali-kheirabadi et al. (2008) reported that during *Eimeria* infection, chickens fed with 200 ppm Diclazuril apparently had more mean body weight and gained more weight than birds of other infected groups.

Coccidiosis caused by parasitic *Eimeria* species remains one of the greatest burdens on the economics of production of poultry and poultry derived products. Approaches in control and management of coccidiosis are prophylactic feeding of anticoccidials, vaccination, and environmental management. Feed additive anticoccidials have been used for over 50 years. It is known that some anticoccidials reduce feed consumption, feed conversion and the absorption of specific nutrient from the intestine (Bell and Weaver, 2002) also, development of resistance in coccidian parasites against commonly used anticoccidials is a great problem (Lillehoj et al., 2010 and Williams, 2006)

Neither of these anticoccidials is completely satisfactory, and new strategies are urgently required. Today, it seems to be more important than ever to find alternative coccidiosis control measures and develop new anticoccidials to provide for poultry producers high level of safety and efficacy. Alternative options include new anticoccidial vaccines, organic and herbal feed additives which should be studied more, as possible alternate for present synthetic anticoccidials.

The authors declare that they have no conflict of interest.

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پارامترهای عملکرد پرورشی طیور در کوکسیدیوز تجربی درمان شده با دیکلازوریل و کلوییدول، نیاز به ارزیابی منابع جدید آنتی کوکسیدیال

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چکیده

زمینه مطالعه: کوکسیدیوز به عنوان یک بیماری انگلی که بیشترین تأثیر اقتصادی را بر تولید طیور دارد، شناخته شده است. صنعت مدرن پرورش طیور به میزان زیادی وابسته به ترکیبات ضد کوکسیدیوز است. **هدف:** مطالعه حاضر جهت تعیین و مقایسه کارایی دو ضد کوکسیدیوز شیمیایی (کلوییدول و دیکلازوریل) بر دفع اووسیست و همچنین اثرات احتمالی آنها بر عملکرد پرورشی و کارایی تغذیه‌ای طیور گوشتی در کوکسیدیوز تجربی انجام شده است. **روش کار:** تعداد ۱۲۰ قطعه جوجه یک روزه نژاد Ross ۳۰۸ بطور تصادفی گروه‌بندی شدند: کنترل مثبت؛ آلوده به کوکسیدیوز بدون درمان، گروه کنترل منفی؛ بدون آلودگی و بدون درمان، گروه CLO؛ آلوده و درمان شده با کلوییدول، گروه DIC؛ آلوده و درمان شده با دیکلازوریل. برای ایجاد کوکسیدیوز تمامی گروه‌ها بجز کنترل منفی با اووسیست اسپوروله عفونی در انتهای هفته سوم تلقیح شدند. میزان دفع اووسیست با استفاده از لام مک مستر شمارش گردید. وزن بدن، وزنگیری و ضریب تبدیل غذایی هر هفته اندازه‌گیری و محاسبه گردید. **نتایج:** شمارش اووسیست نشان داد که دیکلازوریل در کاهش تعداد اووسیست کارآمدتر از کلوییدول بود. میانگین وزن بدن در گروه کنترل مثبت از سایر گروه‌ها پایین‌تر بود. ولی در انتهای مطالعه میانگین وزن در گروه‌های درمان شده با کلوییدول و دیکلازوریل با گروه کنترل مثبت تفاوت معنی‌داری را نشان نداد. در مقایسه وزنگیری میان گروه‌های مختلف بجز در هفته چهارم و پنجم در سایر هفته‌ها تفاوت معنی‌داری مشاهده نشد. بر پایه نتایج بدست آمده از FCR اضافه نمودن ترکیبات آنتی کوکسیدیال اثر معنی‌داری بر بهبود آن نداشت. **نتیجه‌گیری نهایی:** گزارش شده است که برخی از ترکیبات ضد کوکسیدیوز منجر به کاهش مصرف خوراک و ضریب تبدیل غذایی می‌شوند. به نظر می‌رسد هیچ‌کدام از ضد کوکسیدیوزهای شیمیایی مورد استفاده در مطالعه حاضر در کنترل زیان‌های اقتصادی کوکسیدیوز به طور کامل مؤثر نمی‌باشند و ارائه استراتژی‌های جدید مورد نیاز می‌باشد.

واژه‌های کلیدی: کوکسیدیوز، دیکلازوریل، کلوییدول، عملکرد پرورشی، طیور گوشتی

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