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Pharmacology

Effect of Dietary Supplementation of Maduramycin (Cygro® 10G) on Controlling of Coccidiosis, Growth Performance, Hematological and Biochemical Parameters in Broiler Chickens

Taha Attia[1], Hosny Elbanna[2], Sameh AboAli[1]

(1) Department of pharmacology, Faculty of Veterinary Medicine, University of Sadat City.

(2) Department of pharmacology, Faculty of Veterinary Medicine, Cairo University.

**corresponding author:* Drsamehaboaly@yahoo.com *Received: 5/4/2021 Accepted: 22/5/2021*

ABSTRACT

The efficacy of maduramycin (Cygro® 10G, recommended dose; 5 mg/kg of feed) as anticoccidial dietary supplementation in broiler chickens infected with coccidial oocysts on hematological profile, serum biochemical parameters and the performance parameters (body weight gain, food intake, food conversion as well as mortality), was studied. A total of 40 one-day-old broiler chicks (body weight: 42.15±0.27gm) were randomly divided into two treatment groups: (a) Infected group without supplementation and (b) Infected group supplemented with Cygro® 10G. Dietary Cygro® 10G supplementation significantly improved weight gain (WG), feed conversion ratio (FCR) and mortality compared to non-supplemented control treatment. WBCs, RBCs, PCV, Hb, MCV, MCH and LYM were showed a significant increase in supplemented group that fed on maduramycin compared to non-supplemented control group. We concluded from the obtained results that maduramicin can improve the feed conversion ratio, reduce feeding cost, and shorten the feeding period.

Keywords: *Maduramycin, broiler chickens, Coccidiosis.*

INTRODUCTION

The poultry industry during the past two decades has been one of the most dynamic and ever-expanding sectors in the world. It helps to fill the gap between requirement and availability of high-quality protein for human consumption. The demand for a higher and safer protein source, free of infectious agents, is getting increased. However, during intensive growth, poultry industry has always been confronted with challenges in the form of various diseases. Among these conditions, the major economic losses are due to infectious diseases which could be caused by viruses, bacteria, fungi, protozoa, and the cost of preventive medication. This led to increased use of antibiotics in the poultry industry for therapeutic, prophylactic and growth promotion purposes.

Coccidiosis is a disease caused by parasites of the genus Eimeria and Isospora belonging to the phylum Apicomplexa with a complex life cycle, affecting mainly the intestinal tract of many species of mammals and birds. It is of great economic significance in farm animals, especially chickens. Most knowledge on coccidiosis has been obtained from chickens, where the disease has been studied most intensively as it is in commercial poultry that this parasite causes the most damage due to the fact that birds are reared together in large numbers and high densities. The economic significance of coccidiosis is attributed to decreased animal production (higher feed consumption, growth depression and increased mortality) and the costs involved in treatment and prevention. Worldwide, the annual costs inflicted by coccidiosis to commercial poultry have been estimated at 2 billion E, stressing the urgent need for more efficient strategies to control this parasite (Reid, 1990)

The anticoccidial products can be classified in three categories according to their origin (Chapman, 1999a, 1999b; Allen and Fetterer, 2002); (1) Synthetic compounds: These compounds are produced by chemical synthesis and often referred to as 'chemicals'. Synthetic drugs have a specific mode of action against the parasite metabolism. For example, amprolium competes for the absorption of thiamine (vitamin B1) by the parasite. (2) Polyether antibiotics or ionophores: These products are produced by the fermentation of Streptomyces spp. or Actinomadura spp. and destroy coccidia by interfering with the balance of important ions like sodium and potassium. The following groups of ionophores exist: Monovalent ionophores (monensin, narasin and salinomycin).Monovalent glycosidicionophores (maduramicin and semduramycin). . Divalent ionophores (lasalocid). (3) Mixed products: A few drug mixtures, consisting of either a synthetic compound and ionophore (nicarbazin/narasin (Maxiban)) or two synthetic compounds (meticlorpindol/ methylbenzoquate (Lerbek)), are also used against coccidiosis.

The presence of antibiotic residues in poultry meat and eggs may have deleterious effects on human consumers. The residues of antibiotics can cause resistance of human flora and pathogenic microbes to those groups of antibiotics. Moreover, cross-resistance to antibiotics used in the therapy of humans and other animals could also resulted (Pelicano *et al.*, 2004).

Polyether antibiotics or carboxyl ionophores constitute a special class of compounds that belong to the broader family of naturally occurring ionophores recorded as potent antibiotics (Westley,1982). The term ionophore, first used in 1967, includes the capacity of the molecule to bind a metal ion and facilitate its transport via cellular membranes.This chemo-physiological property has made polyether ionophores a useful tool in the study of cation transport mechanisms and has been the rationalization for their biological activities (Pressman and Deguzman, 1977).

By altering the permeability of cell membranes to cationic metal species, polyether antibiotics are assumed to affect their targeted cells. Polyether ionophores have special structural properties that are essential to their ability to communicate with metal organisms (Lutz *et al.*, 1971 & Dorkov, 2008). Ionophores facilitate transport of ions across biologic membranes (Meliton and Novilla, (2018). Elevated transmembrane ion fluxes and gradient dissipation result in the anticoccidial and antibacterial activities of ionophores, such as maduramycin.

For the short life cycle of a broiler, the preventive program for coccidiosis used usually aims for eliminating Eimeria from the gut by using coccidiocides that kill the parasites. This results in optimal condition of the gastrointestinal tract, improving body weight and feed conversion rate (McDougald, 2003).

In the present study we will explore the effect of maduramycin on broiler chicken's performance, biochemical and hematological parameters on broiler chickens infected with coccidia.

MATERIAL AND METHODS

Materials:

Drug: Polyether antibiotics maduramycin (Cygro® 10G, dose used; 5 mg/kg of feed).

***Chickens*:** A total of 40 one-day-old Hubbard broiler chicks with average body masses (42.15 ± 0.27 gm) were purchased from a local commercial hatchery. Feed and water were provided ad libitum throughout the study, and all broiler chicks were fed in the same house under a relative humidity of approximately 65 %. The temperature was 33 °C in the first week and then decreased gradually to 24 °C by the 4th week, then maintained at 24°C to the end of the experiment. Lighting was provided 24 h/day. All birds were fed from 1 to 14 days on a maize and soybean diet, including a starter (23% CP and ME 3000 kcal/kg feed), and a finisher (21% CP and ME 3100 kcal/kg feed) from 15 to 42 days.

All 40 chicks were randomly distributed in to two groups as; Group (1): 20 chicks were fed on corn and soybean basal control diet without Cygro® 10G, this group considered control negative. Group (2): 20 chicks were fed on corn and soybean basal control diet supplemented with Cygro® 10G, dose used; 5 mg/kg of feed.

Both groups were infected on 14th day, all birds were experimentally infected with Eimeria maxima orally inoculated with 0.1 ml of solution containing 2-5 $\times 10^4$ sporulated oocysts of E. maxima (Obtained from Parasitology

Department, Faculty of Veterinary Medicine, Cairo University).

2-Methods:

All birds in two groups were weighted individually on hatching day and the end of each week till the end of experiment. The amounts of added feed to each pen were recorded daily and remained feed in each pen were weighed weekly. Feed consumption was calculated weekly, our protocol was performed according to (Alkhalf *et al.*, 2010). At the end of each week Feed conversion ratio (FCR) was calculated by dividing the weight of feed consumed in grams for each bird during a period of time by the body weight gain of the same bird in the same group at the same given time. The daily number of dead birds as a result of coccidial infection and mean body weight gain at the end of the experiment were recorded and calculated for each group. All dead birds were removed daily in the morning. At the terminal of feeding trial, five chickens from each group were picked randomly and blood samples were obtained from wing vein. The blood samples were collected into individual tubes and clotted at room temperature for 2 hrs. The serum was separated by centrifugation (3000 g for 10 min) and then stored at -20 °C before CBC, ALT, AST, Urea and Creatine analysis is performed (Azarin *et al.*, 2014).

Data were calculated as mean ± standard error and were statistically analyzed using according to (Petrie and Watson, 2013). Comparison of the mean values was performed and differences were considered statistically significant when $P \leq 0.05$.

RESULTS

All broiler chickens infected by coccidia at 14 day and supplemented with corn and soybean basal control diet without maduramycin had exhibited no significant difference in weight gain (WG) and Feed conversion ratio (FCR) in the 1st and 2nd week compared with treated group but exhibited significant decrease in weight gain ($p \leq 0.001$) and significant decrease in feed consumption ratio ($p \leq 0.01$) from 3rd to 5th week compared with treated group and high mortality rate, as seen in (Table 1).

All broiler chickens infected by E. maxima at 14 day and supplemented with corn and soybean basal control diet in addition to Maduramycin from the 1st day had exhibited no significant effect on the feed consumption (FC) but showed improved FCR and also, showed improved weight gain (WG) , as seen in (Table 1).

E. maxima develops in the small intestine, where it causes dilatation and thickening of the wall; petechial hemorrhage; and a reddish, orange, or pink viscous mucous exudate and fluid. The exterior of the midgut often has numerous whitish pinpoint foci, and the area may appear engorged. The oocysts and gametocytes (particularly macrogametocytes), which are present in the lesions, are distinctly large.

Infected non-treated group showed that the small intestine, where dilated and thickening of the wall; petechial hemorrhage; and a reddish, orange viscous mucous exudate. Infected treated group showed that the small intestine normal in appearance and its lumen mucosa is pale and increased amount of watery intestinal contents.

The result of Haematological and Biochemical parameters are showed in (Table 2).

Fresh fecal dropping (1gm) were collected after 4 days form E. maxima infection for consecutive 6 days post infection and examined microscopically for coccidia oocyst count. The mean number of oocysts per gram feces for each group was counted by the Mc-Master technique (Table 3).

Table (1): Comparison of growth performance of broiler supplemented with maduramycin (Cygro® 10G) with non-supplemented control group:-

Parameters		Control	Cygro® 10G
1st week	BW(g) mean	176.01±6.4392	177.72±3.168
	FC(g)/bird	150.77	150.07
	WG(g)/bird	133.25±2.38	136.23±1.6
	FCR	1.126±0.25	1.124±0.29
	Mortality	0	0
2nd week	BW(g) mean	454.81±4.954	457.22±5.427
	FC(g)/bird	324.13	325.23
	WG(g)/bird	277.16±1.58	280.74±3.65
	FCR	1.151±0.19	1.145±0.07
	Mortality	1	0
3rd week	BW(g) mean	793.87±4.91	879.97±10.32
	FC(g)/bird	481.43	550.37
	WG(g)/bird	338.01±1.8	425.79±1.58
	FCR	1.724±0.28	1.376±0.33
	Mortality	5	3
4th week	BW(g) mean	1237.49±4.102	1435.08±3.783
	FC(g)/bird	812.54	911.45
	WG(g)/bird	489.642±1.33	545.88±2.77
	FCR	2.156±0.16	1.675±0.22
	Mortality	4	3
5th week	BW(g) mean	1778.69±3.881	2083.72±4.35
	FC(g)/bird	1109.57	1269.48
	WG(g)/bird	552.824±1.11	650.51±1.99
	FCR	2.47±0.25	1.981±0.18
	Mortality	2	0
6th week	BW(g) mean	2335.72±3.761	2750.02±3.69
	FC(g)/bird	1422.26	1468.29
	WG(g)/bird	568.82±2.7	695.02±2.5
	FCR	2.637±0.34	2.202±0.19
	Mortality	1	0

Table (2): Comparison of Haematological and Biochemical parameters of broiler supplemented with maduramycin (Cygro® 10G) with non-supplemented control group:-

Parameters		Control	Cygro® 10G	Unit
Hematological parameters	**WBCs**	17.33 ± 2.79	15.19 ± 2.49	× 1000 /µl
	RBCs	1.41 ± 2.69	2.80 ± 0.58	× 1000 /µl
	Hb	8.61 ± 0.26	12.33 ± 1.71	g/dl
	PCV	28.32 ± 2.43	33.69 ± 2.27	%
	MCV	120.39 ± 1.87	117.28 ± 3.19	Fl
	MCH	41.46 ± 1.63	38.92 ± 4.81	Pg
	MCHC	25.89 ± 2.98	28.71 ± 2.21	g/dl
	Neutrophil	33.35 ± 1.56	22.22 ± 2.78	%
	Lymphocyte	61.75 ± 2.61	66.05 ± 2.39	%
	Monocyte	6.63 ± 1.69	4.06 ± 1.29	%
	Eosinophil	4.48 ± 1.34	3.77 ± 2.46	%
Serum parameters	**ALT**	16.71 ± 1.89	12.33 ± 1.21	u/l
	AST	268.44 ± 2.31	225.67 ± 1.28	u/l
	Uric acid	6.71 ± 1.33	3.83 ± 1.29	mg/dl
	Creatine	1.67 ± 0.38	0.58 ± 0.026	mg/dl

Table (3) Comparison of feacal oocyst count of broiler supplemented with maduramycin (Cygro® 10G) with non-supplemented control group:-

day/group	Infected treated by Maduramycin	Infected not treated
1st day	Zero	Zero
2nd day	5600	33500
3rd day	32000	105000
4th day	62000	324000
5th day	21000	99000
6th day	10000	20000
Total	130600	581500

DISCUSSION

Maduramicin (MD), which was developed from Actinomadurarubra in 1983, is a monoglycoside polyether ionophore antibiotic, it has been widely used as an anticoccidial drug in poultry production (Dorne *et al.,* 2013).

As a feed additive, Maduramicin can improve the feed conversion ratio, reduce feeding cost, and shorten the feeding period. (Lutz *et al.*,1971& Dorkov, 2008).

Several Eimeria species are able to cause clinical signs in infected and unprotected birds; however subclinical infections are frequently seen. These are frequently underestimated but often contribute to impaired conversion of feed and decreased gain in weight. Coccidiosis typically happens most often during the warmer months of the year. The present study showed that maduramycin from the 1st day (5 mg of Cygro® 10G per kg) had exhibited no significant effect on the feed consumption (FC) of broilers compared with control (-ve) group that fed on corn and soybean basal control diet but showed improved FCR compared with control (-ve) group and also showed improved weight gain (WG) in comparison with control (-ve) group .

This finding is in agreement with previous reports of (Fang *et al.,* 2012) who found that application of Maduramicin Ammonium could significantly increase the weight gain of chicken, and had a good promotive effect on the growth of chicken.

Daily supplementation with corn and soybean basal control diet from the 1st day only without any treatment added for the feeding and on day 14, all birds were experimentally infected with oocysts of Eimeria maxima had exhibited significant decrease in weight gain and significant decrease in feed consumption ratio after infection compared with control group B and high mortality rate and this is the typical clinical findings and losses of coccidiosis in poultry as described before.

At the end of feeding trial, a comparison of hematological and biochemical parameters of broiler chickens infected with coccidia which supplemented with corn and soybean basal control diet with control (-ve) group exhibited a slight increase in WBCs, Neutrophils, MCV, MCH, ALT, AST, Uric acid & Creatine but showed a significant decrease in RBCs, Hb, PCV, Lymphocyte & Monocyte percentage and MCHC with no significant difference in Eosinophil. This finding is in agreement with previous reports in broiler (Al-Baadani *et al.,* 2018) who found a significant increase of Neutrophils, a significant decrease of Lymphocyte, a significant increase of WBCs and a significant decrease of RBCs, Hb& PCV.

CONCLUSION

In conclusion, results clearly show that supplementation with Maduramycin (Cygro® 10G) play an important role in control of coccidiosis in poultry and gives better body weight performance, biochemical and hematological parameters in broiler chickens.

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