Journal of Animal Research: v.7 n.5, p. 913-917. October 2017

DOI: 10.5958/2277-940X.2017.00139.5

Effect of Breed, Coccidial Dosage and their Interaction on Body Weight Gain and Oocyst Outputs against *Eimeria tenella* Infection in Two Broiler Strain of Chicken

Mohan Singh Thakur[1*] and Amit Kumar Jha[2]

[1]*Department of Animal Genetics and Breeding, N. D. V. S. U., Jabalpur, Madhya Pradesh, INDIA*
[2]*Department of Animal Genetics and Breeding, College of Veterinary Science & A.H., Rewa, INDIA*

**Corresponding author: MS Thakur; Email: drmohansingh@gmail.com*

Received: 07 Aug., 2017 **Revised:** 22 Sept., 2017 **Accepted:** 26 Sept., 2017

ABSTRACT

The research work was planned on 120 unsexed day old broiler chicks, sixty each of Cari Vishal and Cobb broiler chicken to notice the effect on body weight gain and oocyst outputs against *E. tenella* infection. The effect of dosage of coccidial challenge was found to be significant ($P<0.05$) only at 4th week of age among treatment groups. The least squares mean (LSM) for body weight (g) differed significantly among two genetic groups from 0 to 8 week of age. Significantly ($P<0.05$) lower body weight gain was recorded in the birds of T_2 group at 4 week of age as compared to control and T_1. The difference was found to be significant in birds between control and T_2 group from 5th to 8th week of age, while it was non significant between T_1 and T_2 groups. The mean OPG was significantly ($P<0.05$) higher in Cobb birds than Cari-Vishal birds from days 5 to 9 post infection (pi). The mean OPG count was noticed significantly higher in Cobb as compared to Cari-Vishal. The mean OPG count of T_1 and T_2 groups differed significantly ($P<0.05$) at day 7, 8 and 9 pi in Cobb and at day 5, 6, 8 and 9 in Cari-Vishal while it was non-significant at days 5 and 6 pi in Cobb and day 7 in Cari-Vishal.

Keywords: Body weight, Coccidiosis, Cobb, Cari-Vishal, oocyst outputs

Avian coccidiosis is caused by different species of *Eimeria* in chickens, of which *E. tenella* is one of the highly pathogenic species that found only in the caeca of birds. It can be recognized by accumulation of clotted and un-clotted blood in caeca and by bloody droppings. Coccidiosis is one of the major problems in poultry industry due to increased morbidity and mortality, extensive damage to the digestive tract, production losses and increased risk of contamination of poultry products for human consumption (Györke *et al*., 2016; Kaboudi *et al*., 2016). The life cycle of *E. tenella* parasites is complex and ends with the formation of oocysts excreted in faeces (Reid *et al*., 2014). An effective immune response to infection has contributed to the development of host genetic diversity through selective pressure, with an increasing number of studies characterizing the role that host genetics plays in disease susceptibility.

There is substantial variation among individuals in susceptibility to a wide variety of parasitic diseases and part of this variation in susceptibility is due to genetic factors. There is a considerable difference in susceptibility between the inbred lines (Bumstead, 1998; Stear and Wakelin, 1998). Therefore, present investigation was undertaken to study the comparative performance the birds of different strains of broiler against different dosages of coccidial infection under similar managemental conditions.

MATERIALS AND METHODS

The present study was carried out on Cari Vishal and Cobb broiler chicken under the research project funded by Madhya Pradesh Biotechnology Council, Bhopal, and operated by Department of Animal Genetics and Breeding, College of Veterinary Science and Animal Husbandry, Nanaji Deshmukh Veterinary Science University (NDVSU), Jabalpur. A total of 120 unsexed day old broiler chicks, sixty each of Cari-Vishal and Cobb broiler chickens, were included in the present study. Chicks from each of the two broiler strains were randomly divided into a control (C) group and two treatment groups (T_1 and T_2) comprising twenty chicks under each group.

Preparation of *E. tenella* inoculums and quantification of dosage

Field isolates of *E. tenella* were collected from the caecum of infected birds. Mucosal scrapings of the caeca were made and examined microscopically for the presence and identification of oocysts and asexual forms of *Eimeria*. After proper identification; the oocysts were collected from the caeca of infected birds and were processed to have inoculums of *E. tenella* in the laboratory. Preparation of *E. tenella* inoculums involved three different steps *viz.,* harvesting of oocysts, sporulation of oocysts and storage of inoculums as per the standard procedure described by Davies *et al.* (1963) with some modifications. For sporulation, positive samples were placed in Petri dishes, conditioned with a solution of 2.5% potassium dichromate at room temperature, and aired daily for up to two days (Gari *et al*., 2008). The *E. tenella* was identified based on morphology of oocysts and sporocysts (shape, color, form index, micropyle, and presence or absence of residual) and time of sporulation (Soulsby, 1982). For positive samples, the intensity of the infection was categorized as described by (Lawal *et al*., 2008). The number of sporulated oocysts in the suspension was estimated using McMaster counting chamber and the volume was adjusted to contain 10,000 and 20,000 sporulated oocysts/ml of suspension.

Coccidial challenge

All the experimental birds were reared under strict coccidial free environment and no anticoccidial drug was administered in any of the experimental birds. Faecal samples of all birds from each group were examined to confirm the absence of *Eimeria spp.,* before the coccidial challenge. Groups T_1 and T_2 were challenged by gavaging 10,000 and 20,000 sporulated oocysts, respectively, to each bird on 21^{st} days of age. The control group was given 1 ml of Hanks Balanced Salt Solution (HBSS).

Recording of body weight

The all chicks from the experiment groups were weighed at day old and at weekly interval upto 8 weeks of age.

Estimation of Oocysts production

Oocyst production was determined in terms of oocysts per gram (OPG) to see oocysts production in experimental birds infected with *E. tenella*. The faecal samples of remaining birds from each group were collected, separately, from day 5 to day 9 post infection and the OPG of faeces for each bird was estimated by following the method of Davies *et al*. (1963), using McMaster counting chamber. Eggs outside the grid were not counted and OPG was calculated by the following formula:

$$\text{OPG} = (\text{No. of oocysts in side 1} + \text{No. of oocysts in side 2}) \times 50.$$

Statistical Analysis

The differences in broiler strains for body weight and oocysts outputs (OPG) as indicators of susceptibility/ resistance to coccidial infection were tested for significance employing the following statistical model (Harvey, 1990).

$$Y_{ikl} = \mu + A_i + C_k + (A \times C)_{ik} + e_{ikl}$$

Where,

Y_{ikl} is the body weight/oocysts per gram of I^{th} bird given k^{th} dose of coccidial infection of belonging to i^{th} breed.

μ is overall mean.

A_i is set of fixed effect due to broiler strain (i=1, 2, 3).

C_k is effect due to dosage of coccidial infection (k=1,2).

$(A \times C)_{ik}$ is interaction between breed and dosage of coccidial infection.

e_{ikl} is random error assumed to be normally and independently distributed with mean zero and a common variance.

RESULTS AND DISCUSSION

Effect of breed, coccidial dose and breed × dose interaction on body weight

The least squares analysis of variance conducted to find out the significance of association of breed, dosage of coccidial challenge and breed × dose interaction at 0 to 8 week of age revealed significant (P<0.01) effect of breed. The effect of dosage of coccidial challenge was found to be significant (P<0.05) at 4th week of age while it was non-significant at remaining stages (*i.e.* 0, 1st, 2nd, 3rd, 5th, 6th 7th and 8th week) among treatment groups. The analysis of variance revealed breed × dose interaction to be non significant at all stages from 0 to 8 week of age (Table 1).

The mean body weight (g) differed significantly between two genetic groups from 0 to 8 week of age but within broiler strains the mean body weight of control, T_1 and T_2 group did not differ significantly (Table 2). The non significant difference in body weight among treatment groups within broiler strain was observed from 0 to 3 week of age as birds of these two genetic groups under study were challenged with coccidial oocysts on 21st day of age. The significantly lower body weight on 4th week of age may be due to the occurrence of severe haemorrhages and lesions in the caeca of infected birds caused by *E. tenella* which in turn reduced feed conversion ratio and thereby poor growth. The differences in body weight gain between coccidial challenge groups among breeds may be due to the established fact that birds of different genetic groups have different immunogenetic responses against the same disease.

In consonance with the present findings of significant difference in body weight between treatments and control groups, Jatau *et al.* (2014) observed significant reductions in the mean weight gain of experimental groups of Cobb and Marshal compared to their controls. However contrary to the present findings, Gabriel *et al.* (2003) reported no differences in weight gain over the whole study period (from 0 to 7 day pi) in four treatment groups *i.e.* I, II, III and IV receiving 0, 5000, 10000 and 20000 sporulated oocysts, respectively per bird at 22 day of age.

Effect of breed and dosage on Oocyst outputs

The Mean Oocyst outputs (OPG) from day 5 to 9 pi

Table 1: Least squares analysis of variance for effect of breed, coccidial dose and their interaction on body weight at 0 to 8 week of age Cobb and Cari-Vishal chickens

Age	Source of variation	Breed	Dose	Breed X Dose	Error
0th week	MS	2888.61 (1)	25.37(2)	28.41 (2)	15.74 (114)
	F-value	183.43**	1.61	1.80	—
1st week	MS	101328.00(1)	437.00(2)	109.00(2)	165.00 (114)
	F-value	614.90**	2.65	0.66	—
2nd week	MS	1143911.00(1)	1953.00(2)	657.00(2)	707.00 (114)
	F-value	1616.98**	2.76	0.93	—
3rd week	MS	5511382.00(1)	5109.00(2)	2009.00(2)	2058.00(114)
	F-value	2677.96**	2.48	0.98	—
4th week	MS	11765220.00(1)	167587.00(2)	19578.00(2)	54722.00(114)
	F-value	215.00**	3.06*	0.36	—
5th week	MS	14797988.00(1)	437549.00(2)	82682.00(2)	160102.00(114)
	F-value	92.43**	2.73	0.52	—
6th week	MS	14904417.00(1)	810265.00(2)	134555.00(2)	307179.00(114)
	F-value	48.52**	2.64	0.44	—
7th week	MS	16739900.00(1)	1030980.00(2)	129932.00(2)	392346.00(114)
	F-value	42.67**	2.63	0.33	—
8th week	MS	18960283.00(1)	15009702.00(2)	167747.00(2)	497010.00(114)
	F-value	38.15**	3.04	0.34	—

*Significant (P<0.05), ** Significant (P<0.01), MS -Mean Sum of squares, Values in parentheses are degree of freedom.

Table 2: Least squares mean (±SE) for body weight (g) at 0- 8 weeks under different treatment groups in Cobb and Cari-Vishal chickens

Age in weeks	Cobb				Cari-Vishal			
	Control	T1	T2	Overall	Control	T1	T2	Overall
0	48.30 ± 0.84	47.40 ± 1.04	47.82 ± 0.96	**47.84 ± 0.62**	46.54 ± 0.88	46.96 ± 1.31	47.38 ± 1.14	**46.96 ± 0.61**
1	136.50^{a} ± 2.32	135.62^{a} ± 3.14	136.80^{a} ± 2.29	**136.32^{a} ± 2.01**	104.62^{b} ± 3.21	104.20^{b} ± 3.69	104.38^{b} ± 3.95	**104.40^{b} ± 1.97**
2	341.14^{a} ± 4.96	340.16^{a} ± 3.01	340.08^{a} ± 4.23	**340.46^{a} ± 4.18**	192.28^{b} ± 7.25	193.32^{b} ± 8.23	193.36^{b} ± 9.09	**192.99^{b} ± 4.10**
3	694.75^{a} ± 11.78	693.35^{a} ± 12.00	694.10^{a} ± 8.44	**694.07^{a} ± 7.18**	294.80^{b} ± 10.69	296.45^{b} ± 11.67	296.60^{b} ± 14.37	**295.95^{b} ± 7.05**
4	1201.00^{a} ± 27.40	1118.02^{ab} ± 20.07	990.07^{b} ± 17.40	**1102.03^{a} ± 14.42**	532.18^{b} ± 17.42	478.77^{b} ± 23.03	412.96^{b} ± 26.01	**474.64^{b} ± 14.19**
5	1495.67^{a} ± 21.73	1405.47^{a} ± 20.02	1342.31^{a} ± 19.39	**1414.48^{a} ± 18.70**	773.19^{b} ± 27.19	680.86^{b} ± 30.49	618.34^{b} ± 33.76	**690.80^{b} ± 19.69**
6	1865.07^{a} ± 42.58	1643.96^{a} ± 36.21	1560.10^{a} ± 38.21	**1689.71^{a} ± 26.03**	1032.25^{b} ± 26.47	913.58^{b} ± 37.06	807.58^{b} ± 30.20	**917.75^{b} ± 28.97**
7	2038.50^{a} ± 39.86	1833.82^{a} ± 31.10	1733.48^{a} ± 33.71	**1868.60^{a} ± 41.98**	1232.42^{b} ± 32.88	1026.84^{b} ± 40.23	980.62^{b} ± 32.77	**917.75^{b} ± 30.32**
8	2242.71^{a} ± 26.73	2033.87^{a} ± 29.34	1938.85^{a} ± 22.39	**2071.81^{a} ± 22.94**	1413.08^{b} ± 31.27	1201.67^{b} ± 35.81	1199.29^{b} ± 33.07	**1271.35^{b} ± 27.98**

Values within rows with different superscript differed significantly (P<0.05).

Table 3: Least squares mean (±SE) OPG (10^6) at day 5 to 9 under different treatment groups in Cobb and Cari-Vishal chickens

Genetic Groups		Day 5	Day 6	Day 7	Day 8	Day 9
Cobb	T1	10753.0^{a}±358.87	14483.0^{a}±541.84	18808.0^{bc}±415.58	10878.0^{c}±665.27	5497.0^{c}±292.64
	T2	11350.0^{a}±185.30	15161.0^{a}±621.19	23161.0^{a}±773.81	17878.0^{a}±583.63	9761.0^{a}±290.82
	Overall	**11051.0^{a}**±210.94	**14822.0^{a}**±421.90	**20985.0^{ab}**±577.68	**14378.0^{b}**±742.56	**7629.0^{b}**±416.69
Cari-Vishal	T1	6419.0^{d}±207.65	10092.0^{d}±263.27	12189.0^{de}±343.45	7964.0^{d}±518.53	4272.0^{d}±249.11
	T2	8350.0^{b}±341.95	12389.0^{b}±388.70	15733.0^{cd}±491.89	12850.0^{b}±931.24	7261.0^{b}±392.99
	Overall	**7385.0^{c}**±260.34	**11240.0^{c}**±307.19	**13961.0^{d}**±426.95	**10407.0^{c}**±680.19	**5767.0^{c}**±345.66

Values within column with different superscript differed significantly (P<0.05).

have been presented in Table 3. The mean OPG differed significantly (P<0.05) among broiler strains, which ranged from 7629.0±290.82 to 20985.0±577.68 in Cobb birds and 5767.0±345.66 to 13961.0±426.95 in Cari-Vishal birds at days 5 to 9 post infection. The mean OPG was noticed significantly higher in Cobb as compared to Cari-Vishal. In Cobb mean OPG count of T_1 and T_2 groups differed significantly (P<0.05) at day 7, 8 and 9 pi while it was non-significant at days 5 and 6 pi. In Cari-Vishal, the OPG count differed significantly (P<0.05) between T_1 and T_2 at day 5, 6, 8 and 9 but not on day 7, where it was non-significant.

The average OPG for each genetic group showed increasing trend till day 7 pi and then started declining and reached minimum at day 9 pi (Table 3). Shojaei (2014) also reported maximum level of OPG count on day 7 post coccidial infections in Arbor Acres and Ross 308 strains of broiler. As far the association of dosage of coccidial challenge and OPG is concerned, our findings are in agreement with the finding of Gabriel *et al.* (2003), Kostadinovic *et al.* (2012) and Shojaei (2014). These workers have also reported significant association of dose with OPG count in chicken. But our findings on the effect of breed and breed x dose interaction could not be compared as there appears no parallel report on the association of breed and breed x dose interaction with OPG. Hence, on the basis of OPG count recorded during the post challenge period (day 5 to 9 post challenge), it can be claimed that Cobb birds were more susceptible than Cari-Vishal strain of broiler.

CONCLUSION

The mean OPG count was noticed significantly higher in Cobb as compared to Cari-Vishal. Hence, on the basis of OPG count recorded during the post challenge period, it can be claimed that Cobb birds were more susceptible than Cari-Vishal strain of broiler.

ACKNOWLEDGEMENTS

The authors are highly thankful to Madhya Pradesh Biotechnology Council, 26-Kisan Bhawan, Bhopal for granting financial support to carry out this research work under MPBTC project on coccidiosis.

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