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EFFECT OF LOW-LEVEL INFECTION OF *EIMERIA TENELLA* FOR A SHORT DURATION ON DEVELOPMENT OF SPECIFIC IMMUNITY IN CHICKEN

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SUMMARY

Two experiments were conducted to determine the effect of inoculation of low levels of *Eimeria tenella* sporulated oocysts for the first one or two weeks of life (trickle infection method) on the development of specific immunity in chickens. Chicken inoculated daily at 1 to 14 days of age with 40 sporulated oocysts of *Eimeria tenella* provided better immunity than in the case of chicken infected at 1 to 7 days only. This treatment was also preferable than those inoculated with 280 sporulated oocysts once at day 1 or day 7 or twice at days 1 and 7 of age.

Better immunity was provided when chicken were infected starting at the age of 1 to 7 days than that observed at later age 7 to 13 days.

INTRODUCTION

The development of natural acquired immunity in chickens to Eimeria infections have been polarized by several investigators (Rose, 1976 and Long, 1987).

Joyner and Norton (1973 and 1976) demonstrated the sequential exposure of the chickens to *Eimeria* parasites which stimulates a response that was capable of protecting chickens from a challenge inoculation. Although this response was usually measured by comparison of weight gain, feed conversion and reduction in lesion scores after challenge, measured responsers usually demonstrated partial protection against challenge (Rose, 1978).

Leathem and Burns (1968) were unable to produce complete imunity to *Eimeria tenella* and most chickens immunized and challenge continue to shed oocysts even in the absence of overt pathological signs.

Bhanushall and Long (1986) investigated that prolonged exposure of chickens to *Eimeria tenella* sporozoites had been shown to induce protective immunity against homologous challenge.

Norton and Joyner (1986) reported that the administration schedule was important for the development of effective immunity. Continuous low-level infection with *Eimeria tenella* oocysts or "trickle infection" had been shown to be safe, effective, practical and provided immunity against *Eimeria tenella* in chicken.

Augustine and Danforth (1990) found that four species of avian *Eimeria invaded* of foreign host birds in the same areas in which they inveaded with the natural host. Repeated inoculation (immunization of chicken with the turkey coccidia. *Eimeria adenoeides)*, partially protected the chicken against a subsequent challenge with $5.8x10^4$ *Eimeria tenella* oocyst. At 6 days post challenge, the weight gain and feed conversion efficiency of the immunized chicken was significantly better than those of the chicken that were not immunized with *Eimeria adenoeides*. Lesion scores and cellular invasion by the sporozoites were significantly lower in immunized birds than in unimmunized group.

Augustine et al., (1991) observed that repeated inoculation of chicken with 10^4oocysts of turkey coccidia, *Eimeria adenoeides* or *Eimeria meleagrimitis* partially protected chicken against challenge with *Eimeria tenella* or *Eimeria acervulina* oocysts.

Stiff and Bafundo (1993) found that the time required to induce absolute immunity to three species of Eimeria in young broiler continuously

exposed to parasite. Acquirition of immunity was measured by cessation of oocyst production in each bird. They demonstrated that regardless of the age of broiler, all were capable of establishing complete protective immunity to *Eimeria tenella, Eimeria maxima* and *Eimeria acervuline* under continuous exposure within 25, 24 and 16 days, respectively.

The purpose of the present study was to investigate the effect of low-level infection of *Eimeria tenella* for a short-duration on development of specific immunity in chicken.

MATERIAL AND METHODS

Eighty one-day-old coccidia-free Hubbard chicken were used for this wrk. The birds were raised in wire-floored cages and kept under hygienic condition. They were divided into 8 equal groups. There were two experimental designs had been conducted. Experiment I included five groups (1, 2, 3, 4 and 5) , while experiment II contained three groups (6.7 and 8). Group 1 included chicken which were inoculated orally via stomach tube with 40 sporulated oocysts. *Eimeria tenella* (Dr Amal H.T. Abd El-Nassar , Dept of Poultry Diseases , Fac.Vet Med.,Zagazig Univ. ,Benha branch) per chick daily from 1 up to 14 days of age (group of trickle infection). Group 2 was orally infected with 280 sporulated oocysts per chick of *Eimeria tenella* at both 1 and 7 days of age (double dose group) as the equivalent to the total dose of group one. The 3rd group of chicken received 40 oocysts of *Eimeria tenella* per chick daily at 7 to 13 days of age. The 4th group was inoculated with 280 oocysts of *Eimeria tenella* at day 7 of age (single dose group). The 5th group of chicken was kept as unimmunized control for chicken of experiment I. The chicken of all five groups of experiment I were challenged with 1000 sporulated oocysts of *Eimeria tenella* per chicken at 18 days of age. The 6th group was infected with 40 sporulated oocysts daily from 1 to 7 days of age. The chicken of the 7th group were inoculated orally with 280 sporulated oocysts once at day one of age. Group 8 was kept as unimmunized control chicken for experiment II. The chicken of experiment II (Groups 6.7 and 8) were challenged with a uniform challenge dose of 1000 sporulated oocysts of *Eimeria tenella* per chicken at 11 days of age.

All chickens were left under observation and then killed at 10 days post-challenged. Cecal lengths were measured and cecal lesion scores were rated on a scale of 1-4, with 4 being the most severe according to Johnson and Reid (1970).

Each cecum with its contents from each chick was homogenized and the number of oocysts per cecum was counted and registered.

RESULTS

Table (1) showed that cecal lengths of infected chicken with low-level (trickle) of sporulated oocysts of *Eimeria tenella* at 1 to 14 days of age and those infected with double-dosed chicken in experiment No. 1 significantly increase than that of non immunized challenged control.

No cecal lesion scores were observed macroscopically in either trickle-infected or double-dosed chicken, while the number of oocysts per cecum was significantly lower.

Cecal lengths of trickled-infected chicken at 7 to 13 days of age were significantly increased than those infected with single-dosed and control chickens.

The cecal lesion scores of trickle-infected and single-dosed chicken were significantly lower in comparison with that of respective control, moreover, the oocyst output was significantly fewer in trickle-infected chicken than in single-dosed or control ones.

In experiment No. 11, cecal lengths of trickle-infected chicken at 1 to 7 days of age significantly increase in comparison with respective control (Table 1). The trickle infected chicken group have significant lower cecal lesion scores and oocysts count in comparison with their respective control.

Table (1): Cecal length, cecal lesion score and total oocyst out put from chicken after challenge with *Eimeria tenella*

Experiment	No. of group	Dose of sporulated oocysts	Age of chicken (days)	Challenge (days)	Cecal length (cm)	Cecel lesion score	Oocyst per cecum
I	1	40x14	1-14	19	$8.10^{a}\pm0.61$	$0.00^{b}\pm0.00$	$3.70^{b}\pm0.01$
	2	280x2	1&7	18	$7.92^{a}\pm0.91$	$0.00^{b}\pm0.00$	$4.01^{b}\pm0.03$
	3	40x7	7-13	18	$6.90^{a}\pm0.11$	$2.30^{a}\pm0.12$	$5.90^{a}\pm0.06$
	4	280x1	7	18	$5.62^{b}\pm0.16$	$3.01^{a}\pm0.13$	$7.80^{c}\pm0.09$
	Control (5)	0	..	18	$4.22^{c}\pm0.30$	$4.00^{c}\pm0.06$	$8.00^{c}\pm0.01$
II	6	40x7	1-7	11	$7.50^{a}\pm0.02$	$2.10^{a}\pm0.02$	$5.70^{a}\pm0.08$
	7	280x1	1	11	$6.00^{b}\pm0.01$	$2.60^{a}\pm0.02$	$5.89^{a}\pm0.04$
	Control (8)	0	..	11	$4.30^{c}\pm0.40$	$4.10^{c}\pm0.05$	$7.2^{c}\pm0.02$

± Standard error

Different letters of means in the same column show significant differences at $P<0.01$.

DISCUSSION

Numerous reports about the immunizing capacity of *Eimeria parasites* in the chicken have been presented by Rose (1976), Long (1987) and rose et al., (1989). Strong immunity against *Eimeria tenella* was shown when chicken were infected with mixed cultures of *Eimeria tenella* and other coccidial species (Johnson et al., 1986).

The present work indicates that trickle infection with 40 sporulated oocysts of *Eimeria tenella* daily for 2 weeks at 1 to 14 days of age, provided better immunity than that of daily trickle infection for one week at 1 to 7 days or at 7 to 13 days of age, double-dosed and single-dosed chicken. Continuous immunological stimulation by trickle infection mehtod for short duration contributed to the development of immunity. These results are in agreement with those obtained by Norton and Joyner (1986) and Stiff and Bafundo (1993).

The immunity provided by trickle infection of chicken for one week was weaker than immunity induced by trickle infection for 2 weeks. This could be attributed to the fact that daily dose of 40 sporulated oocysts of *Eimeria tenella* for one week may be not sufficient for immunological response in chicken.

Partial immunity in chicken was most rapid developed by trickle infection for one week at 1 to 7 or 7 to 13 days of age.

Tricle infection of chicken at 1 to 7 days of age provided better immunity against challenge with 1000 sporulated oocysts of *Eimeria tenella* than that of trickle infection at 7 to 13 days. These results might be attributed to different maturation levels of the immune system, differences in age related abillity of chicken to excyst sporozoites and different levels of maternal antibody in chicken. These results are in agreement with those quoted by Rose (1967).

REFERENCES

Augustine, P. C. and Danforth, H. D. (1990): Avian Eimeria: Invasion in froeign host birds and generation of partial immunity against coccidiosis. Avian Dis. 34: 196-202.

Augustine, P. c. Danforth, H. D. and Barta, J. R. (1991): Development of protective immunity against *Eimeria tenella* and *Eimeria acervulina* in White Leghorn chickens inoculated repeatedly with high doses of turkey coccidia. Avian Dis. 35: 535-541.

Bhanushali, J. K. and Long, P. L. (1986): Role of sporozoite induced immune responses in protection against *Eimeria tenella* in vivo and in vitro studies. In: Research in avian coccidiosis. L. R. McDougald, L. P. Joyner and P. L. Long, eds. University of Georgia, pp. 526-534.

Johnson, J. K., Mckenzie, M. E., Perry, E. and Long, P. L. (1986): The immune response of young chickens given "graded" or "trickle" infection with coccidia . In Research in avian coccidiosis. L. R. McDougald, L. P. Joyner and P. L. Long, eds University of georgia Athens, Ga. pp. 634-641.

Johnson, J. and reid, W. M. (1970): Anticoccidial drugs: Lesion scoring techniques in battery and floor pen experiments with chickens. Exp. Parasitol, 28:30-36.

Joyner, L. P. and Norton, C. C. (1973): The immunity arising from continuous low-level infection with *Eimeria tenella*. Parasitology 67: 333-340.

Joyner, L. P. and Norton, C. C. (1976): The [illegible] arising from continuous low-level with *Eimeria* [illegible] and *Eimeria acervulina*. Parasitology 72:115-[illegible]

Leathem, W. D. and Burns, W. C. (1969): [illegible] acquired immunity of the chicken to *Eimeria* [illegible] infection J. Parasitol. 54: 227-232.

Long, P. L. (1987): Coccidiosis in poultry. Clin Rev.Poult. Biol. 1: 25-50.

Norton, C. C. and Joyner L. P. (1966): Avian [illegible] The administration of encapsulated [illegible] Parasitology. 92: 499-510.

Rose, M. E. (1967): The influence of age of [illegible] infection with *Eimeria tenella*. J. Parasitol. 53: [illegible]

Rose, M. E. (1976): Coccidiosis: immunity [illegible] prospects for prophylactic immunization . Vet. 481-484.

Rose, M. E. (1978): Immune responses of [illegible] coccidia and coccidiosis In : Avian coccidia Long, K. N. Boorman and B. M. Freeman, [illegible] 13th Poultry Science Symposium. British Science Ltd., Longman Group Ltd., [illegible] Scotland, pp. 297-397.

Rose, M. E. and Wakelin, D. (1989): Mech immunity to coccidiosis. In : Coccidia and coccidiomorphs. P. Yvore, ed. Institut N Recherche Agronomique. Paris, pp. 527-540.

Stiff, M. I. and Bafundo, K. W. (1993): Dev immunity in broilers continuously exposed *sp.* Avian Dis. 37: 295-301.