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Effect of Season on the Immunity of Newly Hatched Broiler Chicks Reared in Arid-Hot Climate

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Abstract: This study was conducted to investigate the effect of the environmental temperature on the immune response of exotic broiler chicks reared in arid-hot climate zone (the Sudan). Twenty eight broiler chicks (Lohman) were challenged with 1 mL of 10% sheep red blood cells suspension (10% SRBCs) at day 2 and day 13 during summer (June) and winter (January) seasons. At day 13 and day 20 sera were harvested and subjected to hemagglutination test to measure antibody titers against 10% SRBCs for primary and secondary immune response, respectively. In winter season the antibody titers (GMT) against 10% SRBCs for the secondary immune response was so high compared to that in summer season. Nevertheless, the antibody titers for primary immune response during winter and summer seasons were, somehow, identical although it was a little bit higher during winter season. The weights of the lymphoid organs (spleen, thymus and bursa of Fabricius) were significantly higher in the winter season compared to summer season irrespective of the age.

Key words: Broiler chicks, seasons, immune response, lymphoid organs, body weight

INTRODUCTION

Many studies have been made to investigate the effect of the environmental temperature on different aspects in poultry, including: sexual maturation (Huston, 1975), fertility (Cowan and Michie, 1980), food intake (Marsden and Morris, 1987), digestibility of amino acids (Reece *et al*., 1984), thyroid gland activity (Cogburn and Harrison, 1980). These studies have been extended to the field of immunity (Gross and Siegel, 1980; Regnier *et al*., 1980; Regnier and Kelley, 1981). However, small attention has been paid to study the effect of the environmental temperature on the immunity of newly hatched broiler chicks, especially under climatic condition of the Sudan.

The central and north parts of the Sudan suffer high environmental temperature during summer season compared to winter season. Nevertheless, during the same season; night and day ambient temperature shows wide range that may create heat episodes.

Therefore, the present study was conducted to investigate the effect of ambient temperature during summer and winter seasons in the Sudan on the immunity of newly hatched exotic broiler chicks.

MATERIALS AND METHODS

The experimental birds and the feeding: Fifty six commercial unsexed Lohman one-day-old broiler chicks (28 for summer season and the same number for winter season) were used in this study. They were kept in a brooder house, where water and feed were offered *ad libitum*.

The experimental diet was formulated according to the specifications of NRC (1994).

Experimental plan: Two experiments were conducted during winter (January) or summer (June) seasons. The metrological data (temperature and relative humidity) in the area of the study for the mentioned periods are presented in Table 1.

At day 2, each chick was challenged with 1 mL of 10% sheep red blood cells suspension (10% SRBCs).

Table 1: Monthly average of some metrological data at the area (Shambat, Khartoum North/Sudan) and the period (January and June) of the study

Months	Min. Temp.	Max. Temp.	Mean Temp.	R. humidity
	---------- (°C) ----------			(%)
January	14.8	31.7	23.2	32
June	26.8	41.4	34.1	29

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Eleven days later, 7 chicks were randomly selected, weighed and killed by severing the jugular vein using scalpel blade size 15. Blood samples were collected in plane vacutainer tubes. Sera were harvested and preserved for detection of antibody titers against 10% SRBCs using hemagglutination technique. Lymphoid organs viz. thymus, spleen and bursa of Fabricius were excised and weighed using Mettler 161 balance. The remainder chicks were challenged with a second dose of 10% SRBCs (1 mL). Eight days later, they were weighed and slaughtered by severing the jugular vein and the harvested sera were subjected to hemagglutination test to detect the antibody titers for the secondary immune response against 10% SRBCs.

Hemagglutination: Before running the hemagglutination test, sera were inactivated at 56°C for 30 min in a water bath. The test was performed according to Singh and Dhawedkar (1993).

Statistical methods: Collected data for lymphoid organs and body weights were statistically analyzed using covariance analysis as recommended by Brown *et al.* (1985). Data were subjected to analysis of variance (ANOVA) using Statistical Analytical System (SAS) Oregon state university computer programme. Results are given as means±SEM (standard error of the means).

The antibody titers were expressed in the form of Geometric Mean Titers (GMT) according to Brough (1978).

RESULTS AND DISCUSSION

Antibody titers against 10% SRBCs: The antibody titers for the secondary immune response during summer season exhibited great depression compared to those at winter season. Nevertheless, the antibody titers for primary immune response during summer and winter seasons were almost identical; however, it was a little bit higher during winter season (Table 2).

Lymphoid organs weight and body weight: The lymphoid organs (spleen, thymus and bursa of Fabricius) weight and the body weight of 12 and 20 day old broiler chicks were significantly smaller in summer season compared to winter season (Table 3, 4).

The present experiments were performed to find out to what extent the seasonal variations can affect the immunity of the imported exotic newly hatched broiler chicks in the Sudan. Khartoum state (Capital of the Sudan, where this study was conducted) is characterized by a very hot summer season, in which the ambient temperature may reach more than 40°C at after noon (Table 1). This creates heat episodes and consequently, it may stress the chicks.

Table 2: Effect of season on the Geometric Mean Titers (GMT) of antibodies in response to 10% Sheep Red Blood Cells Suspension (SRBCs) challenged at day 2 (primary immune response) and day 12 (secondary immune response)

Season	Day 12	Day 20
Summer	4.6	8.6
Winter	4.9	675.6

Table 3: Effect of season on body weight (g) and lymphoid organs weight (g) in 12-day old broiler chicks

	Lymphoid organs weight (g)			Body weight
Season	Spleen	Thymus	Bursa of Fabricius	(g)
Summer	0.07±0.02[a]	0.16±0.04[a]	0.24±0.06[a]	149.9±10.2[a]
Winter	0.25±0.05[b]	0.72±0.08[b]	0.63±0.04[b]	280.6±7.5[b]

[ab]: Values within the same column, with the same superscript(s) are not significantly different at 5% probability

Table 4: Effect of season on body weight (g) and lymphoid organs weight (g) in 20-day old broiler chicks

	Lymphoid organs weight (g)			Body weight
Season	Spleen	Thymus	Bursa of Fabricius	(g)
Summer	0.23±0.08[a]	0.71±0.12[a]	0.50±0.03[a]	356.3±15.6[a]
Winter	0.72±0.14[b]	2.24±0.56[b]	1.86±0.17[b]	511.9±21.4[b]

[ab]: Values within the same column, with the same superscript(s) are not significantly different at 5% probability

Heat episodes have a greater effect during the declining phase of the immune response (Siegel and Latimer, 1984). They claimed that this may be primarily due to suppression of IgG and it is most apparent when high antigens concentrations are used. Similarly, oral doses of prednislone have shown to depress IgG concentration in human (Butler, 1975). On the other hands, the sustained exposure to high temperature was found to have longer term cytolytic effects that reduce IgG synthesis (Burton *et al*., 1967; Mayer *et al*., 1982). Note worthy, Siegel and Latimer (1984) reported that the declining in the immune response depends on the number and the spacing of the heat stress episodes. This could be considered in consistent with our findings when we scoped them under the climatic condition of the area of the study. Moreover, the present findings agree with the findings of Thaxton and Siegel (1970), that high environmental temperature depresses the immune response in young chickens. However, the present study showed that the primary immune response was not affected by high environmental temperature in comparison to secondary immune response, which showed drastic depression. The fact that the primary immune response was not affected may be due to the delayed response produced by heat. A similar explanation was provided by Siegel and Latimer (1984). Another explanation for this finding could be due to the presence of the residual yolk

sac during this period (undergoes regression by the end of the 5th day post-hatch). The yolk sac contains different types of vitamins, one of them is vitamin E, which improves the immune response against SRBC in turkey and broiler chicks (Ferket *et al*., 1993; Gore and Qureshi, 1997). Therefore, it may help the chicks to overcome the effect of the heat stress on the immunity during the first 5 days post-hatch.

Furthermore, this study showed that the lymphoid organs as well as the body weight were regressed during summer season compared to winter season and this finding is in consistent with the previous reported one (Freeman, 1988).

As a conclusion, the broiler chicks show different potentialities and responses during different seasons. The immune response to 10% SRBCs, lymphoid organs (spleen, thymus and bursa of Fabricius) weights as well as the body weight were lower during summer season compared to winter season.

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