

THE INTERACTION EFFECT OF STRAIN, SEX AND LIVE BODY WEIGHT ON ANTIBODY RESPONSE TO SRBC_s IN BROILER CHICKENS

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Abstract:

An experiment was designed to evaluate the effect of both strain and sex against of SRBCs antigen on live body weight, at different ages in broiler chickens. The experimental extended from June to July 2007, in order to investigate the relationship between the general immune response to SRBCS antigen on body weight traits in broiler chicks at one cycle. Two different commercial strains (ISA Hubbard and Ross 308) were used. Chicks were brooded and reared under similar environmental condition and raised on deep litter up to marketing age (7 weeks). The feed and water were provided *ad libitum*. Individual body weight of 500 chicks was recorded for each strain (250 per each) separately at 0, 1, 2, 3, 4, 5, 6 and 7 weeks of age. Prepared antigen (SRBC 2.5%) was injected individually in all birds with 0.13 dose at 28 day of age. Then, chickens were bled from the wing vein at 7, 14 and 21 day post- injection for anti-body (Ab) levels determination. Means of Ab – titers were 6.91 and 5.66 at 7-d post – injection in ISA Hubbard and Ross 308, respectively, with highly significantly differences ($p \leq 0.001$) between strains. While, females had higher Ab – titers than males, but the difference were not significant. On other hand, Ab - titers at 7, 14 and 21 - d post injection in both broiler strains had negative phenotypic correlations with body weight at 7- Wks of age, being – 0.049, – 0.008 and – 0.041, respectively.

INTRODUCTION

One of the concerns of commercial poultry farmers is the protection of their flocks against disease challenge. This objective could be achieved through selecting birds that are resistant against particular pathogens, and/or those displaying better immunocompetence, i.e., the general quality of host's immune system to launch sufficient defense against

infections (**Knap and Bishop, 2000**). Previous studies have linked genetic makeup of poultry to disease resistance and/or susceptibility (**Lamont et al., 1987; Lakshman et al., 1997; Poulsen et al., 1998; Yonash et al., 2001**). Furthermore, genetic improvement for growth performance over the years has been seen to negatively influence immune performance of chickens. High

growth rate in broiler chickens has also been linked to increased susceptibility for Marek's Disease **Gebriel et al., 1979** and Presently, the aim of commercial poultry breeding is to achieve higher body weight and maximum egg production per unit of feed intake. However, there is a negative correlation between production traits and immunity in chickens because of the conflict between some production and immunity, i.e. maturation and function of the immune system. The genotypes with the maximum body weight exhibit lower immunity (**Gebriel, 1990 and Nestor et al., 1996**)

Mortality due to Marek's Disease challenge showed higher in males than in females of $B^{13} B^{21}$ Cornell Random bred White Leghorn chickens divergently selected for low antibody response to SRBC signifying a sex effect in disease susceptibility (**Martin et al., 1989**). Furthermore, age of the chickens also has an effect on immune performance. Due to immunological immaturity, young chickens have a greater incidence of diseases such as infectious bursal disease, avian encephalomyelitis, Marek's Disease, *E. coli* and Salmonella infections (**van der Zijpp, 1983**).

MATERIALS AND METHODS

1. Genetic stocks and management:

The experiment of this study was carried out at Private Breeding Farm of poultry production Toukh city, Kaluobia Governorate, Egypt, during 49 days in summer 2007, in order to investigate the relationship between the general immune response to SRBC_s and some productive traits in broiler chicks. Two different commercial strains, named ISA Hubbard and Ross 308, were used. Data collected from 500 chicks (250 chicks from each strain) were used. All chicks were brooded and reared under similar environmental conditions and raised on deep litter up to marketing age (7 weeks). Feed and water were provided *ad libitum*. They were fed a diet containing 23% crude protein and 3000 k.cl ME/kg in starter formula, 21% crude protein and 3050 k.cl ME/kg in grower formula and 19% crude protein and 3150 k.cl ME/kg in finisher formula. The load number was

(intensity numbers 10 birds /m²). All chicks exposing to similar environmental condition during experimental period.

2. Immunization with SRBC_s antigen:

Sheep red blood cells (SRBC_s) were chosen as natural immunizing antigen to elicit the antibody response in the chicks. The prepared SRBC_s antigen (2.5%) was injected individually in the wing vein with 0.13 ml at 28- day of age according to the method of **Van der Zijpp and Leenstra (1980)**.

Studied traits

1. Body weights:

Individual body weight was recorded for each strain separately at 0, 1, 2, 3, 4, 5, 6, 7, weeks of age. At 5- wk of age chicks were divided into three lines (light, control and heavy) for body weight according to (mean ± S.E).

2. Determination of antibody response:

The primary antibody titer to SRBC_s was determined for all individuals at 5- weeks of age. Blood sample were collected at 7, 14, and 21-day post- immunization with a syringe from the wing vein. About 2-3 ml of blood were taken from each chicken, serum was collected and antibody titers were determined using micro haemagglutinin as described by **Van der Zijpp and L eenstra (1980)** method.

Antibody titer was expressed as log₂ of reciprocal of the last serum dilution showing haemagglutinin.

3. Statistical analysis:

Data were analyzed using the General Linear Models (GLM) procedure of SAS software (**SAS Institute, 1996**). Differences among means were tested based on Duncan test, (**Duncan, 1955**).

Results and Discussion

1. Effect of strain and sex on body weight before SRBCs injection:

Means of body weight were ranged from 38.95 to 907.2g and 36.7 to 827.4 g at hatch to 4- wks of age in ISA Hubbard and ROS 308 strains respectively (**Table 1**). On the other hand, means of body weight in males were (38.61 and 891.26 g), but in females were (37.08 and 843.35 g) at hatch and 4- wks of age, respectively (**Table 1**).

Results in (**Table 2**) showed that, the statistical difference between the two strains and sex effect were highly significant ($P < 0.001$) in live body weight at different ages (from hatch up to 4- wk of age). While, the interaction between strain and 4th weeks of age (**Table 2**).

and sex effects was highly significant ($p \leq 0.001$) in live body weight at 1st, 2nd, 3rd

These results agree with **Gavora, (1993)** who found that, body weight in chickens is a typical quantitative trait, affected by many genetic, as well as environmental factors. Others (**Dunnington et al., 1986; Leitner et al., 1992; Pinard et al., 1993; Parmentier et al., 1996**) have demonstrated the feasibility of selection based on body weight and suggested that it may improve disease resistance. However, the immunocompetence of such lines has never been reported under farm condition.

Table (1):Least square means of strain and sex effects on live body weight at different ages.

Effect	Age of chicks				
	At hatch	1- WK	2-WK	3-WK	4-WK
<u>Strain effect</u>					
ISA Hubbard	38.95 ± 0.11	162.34 ± 0.61	312.22 ± 1.66	553.65 ± 2.85	907.22 ± 3.16
Ross 308	36.74 ± 0.11	154.15 ± 0.61	258.47 ± 1.69	496.91 ± 2.88	827.40 ± 3.20
<u>Sex effect</u>					
Male	38.61 ± 0.12	179.39 ± 0.61	310.04 ± 1.67	558.41 ± 2.87	891.62 ± 3.18
Female	37.08 ± 0.12	137.37 ± 0.61	260.66 ± 1.67	492.15 ± 2.87	843.35 ± 3.18

Table (2): F- rations of least square analyses of factors affecting live body weight at different ages.

S.O.V	Body weight ⁺									
	WK0		WK1		WK2		WK3		WK4	
	d.f	M.S	d.f	M.S	d.f	M.S	d.f	M.S	d.f	M.S
Strain	1	562.0	1	7755.6	1	334283.4	1	372547.7	1	737256.8
Sex	1	270.8	1	206756.5	1	282226	1	507967.4	1	265697.3
Strain × Sex	1	25.7	1	4466.2	1	61197.6	1	136073.3	1	101126.3
Error d.f	489		479		475		467		462	
Error M.S		3.2		86.4		650.1		1905.2		2345.6

ns = non significant, *** = p<0.001.

⁺ WK0, WK1, WK2, WK3 and WK4 = body weight at 0, 1, 2, 3 and 4 weeks of age, respectively.

2. Effect of strain and sex on live body weight after SRBCs injection:

As shown in (Table 3), chicks of ISA Hubbard had heavier body weight than Ross 308 strain at 5 to 7 weeks of age reaching the highest body weight at 7- wk being 1636.8 g for Hubbard and 1529.40g for Ross. The difference between the two strains of chickens was highly (P≤0.001) significant (Table 5).

Furthermore, body weight average of males of both ISA Hubbard and Ross 308 strains was heavier than female at 5 and 6 weeks of age, after injection with SRBC (Table 3). In spite of, the difference between males and females in body

weight was non-significant at 5 and 7-wk of age, but it was highly significant (p≤0.001) at 7- wk of age (Table 5). This may be due to the fast growing of males than females (Brake *et al.*, 1993).

Results in (Table 4) showed that chicks had high antibody titers were low in body weight compared with low and, control antibody levels. The difference between both low line (LL) and control (CL) and high lines (HL) was significant (P≤ 0.05) at different age (Table 4). These results agree with the results reported by Parmentier *et al.*, (1998) who found that the high immune response line chickens

were significantly lower in body weight at 38 WK of age than the control and low line selected for antibody response to SRBCs. In addition, there was no significant difference

in interaction between strain x line, sex x line and strain x sex x line in body weight. However, these interactions were significant ($P \leq 0.05$) at only 7- wk of age.

Table (3): Least square means of strain and sex effect on live body weight at different ages against SRBCs injection.

Effect	Age of chickens		
	5-WK	6-WK	7-WK
<u>Strain effect</u>			
ISA Hubbard	1307.01 ± 4.0	1506.8 ± 3.82	1636.83 ± 7.21
Ross 308	1174.50 ± 3.44	1376.1 ± 3.90	1529.40 ± 6.16
<u>Sex effect</u>			
Male	1243.13 ± 3.7	1444.88 ± 3.51	1599.02 ± 6.63
Female	1238.37 ± 3.8	1436.73 ± 3.52	1567.20 ± 6.78

Table (4): Least square means of live body weight at different ages as affected by antibody titer levels (low, control and high).

Line ⁺	Age of chickens		
	5- wk	6- wk	7- wk
Light	1235.49± 3.83 b	1438.63 ± 3.94 b	1579.34 ± 6.89 b
Control	1243.45± 3.99 b	1442.12 ± 4.12 b	1583.78 ± 7.15 b
Heavy	1243.32± 5.69 a	1443.66 ± 5.88 a	1586.21± 10.20 a

Means with the same letters in each column are non- significantly difference ($p < 0.05$)

⁺ Low level (0: 3.3), control level (3.4: 9.3) and high level (9.4: >). These levels were distributed according to (mean ± S.E).

Table (5): Analyses of variance of strains, sex and antibody level affecting live body weight at different ages after injection with SRBC_s age.

S.O.V.	WK5		WK6		WK7	
	d.f	M.S	d.f	M.S	d.f	M.S
Strain	1	*** 1685364.1	1	*** 1616110.09	1	*** 1086445.89
Sex	1	ns 2182.37	1	ns 8471.19	1	*** 95383.73
level	2	ns 3315.44	2	ns 902.06	2	ns 1585.38
Strain x Sex	1	*** 8317.02	1	*** 6582.45	1	*** 7579.52
Strains x level	2	ns 3101.99	2	ns 2882.18	2	ns 26869.90
Level x sex	2	ns 37398.90	2	ns 42480.19	2	* 109980.34
Strain x Sex x level	2	ns 834.22	2	ns 1677.74	2	* 23899.85
Error	450	2674.37	446	2841.4	412	8628.26

ns = non significantly, * = $P < 0.05$, *** = $P < 0.001$

3. Effect of strain and sex on titers of antibody after injection with SRBC_s:

The means of antibody (Ab) titers of ISA Hubbard was higher than ROS 308 strain at different ages (7, 14, and 21 days) post injection (**Table 6**). In genetically, the highest level of Ab- titers occurred at 7-days post- injection, then declined gradually to 21- days post- injection in all chickens of

returned to sensitivity degree of strains aga both strains. The difference of Ab titers between the strains was highly ($P < 0.001$) significant (**Table 7**). These results may be inst SRBC injection and immune system activation which differs from strain to another, this agree with results of **Shadi (2006)** on the same strains.

On the other hand, the Ab titers of females were higher than males at 7, 14 and 21 days post injection (Table 6 and Fig.1) but the difference between them was

not significant (Table 7). The same results showed by (Siegel and Gross, 1980; Leitner *et al.*, 1992; and Parmentier *et al.*, 1996) in chickens.

Table (6): Least square means of antibody titer after injection with SRBC at different age as affected by strain and sex effect.

Factor	Age of chickens		
	Ab-7 d	Ab -14 d	Ab -21 d
<u>Strains effect</u>			
ISA Hubbard	6.91 ± 0.19	4.0 ± 0.12	2.19 ± 0.05
Ross 308	5.66 ± 0.19	3.1 ± 0.12	1.79 ± 0.05
<u>Sex effect</u>			
Male	6.06 ± 0.19	3.32 ± 0.12	1.89 ± 0.05
Female	6.51 ± 0.19	3.76 ± 0.12	2.1 ± 0.05

Table (7): Analyses of variance of factors affecting antibody titers after injection with SRBCs at 28 day of age.

S.O.V	Ab 7d		Ab14d		Ab 21d	
	d.f	M.S	d.f	M.S	d.f	M.S
Strain	1	180.22	1	94.68	1	17.93
Sex	1	23.78	1	22.11	1	4.95
Strains× sex	1	0.26	1	0.494	1	0.70
Error	459	8.27	457	3.63	454	0.78

ns = non significant *** = p<0.001

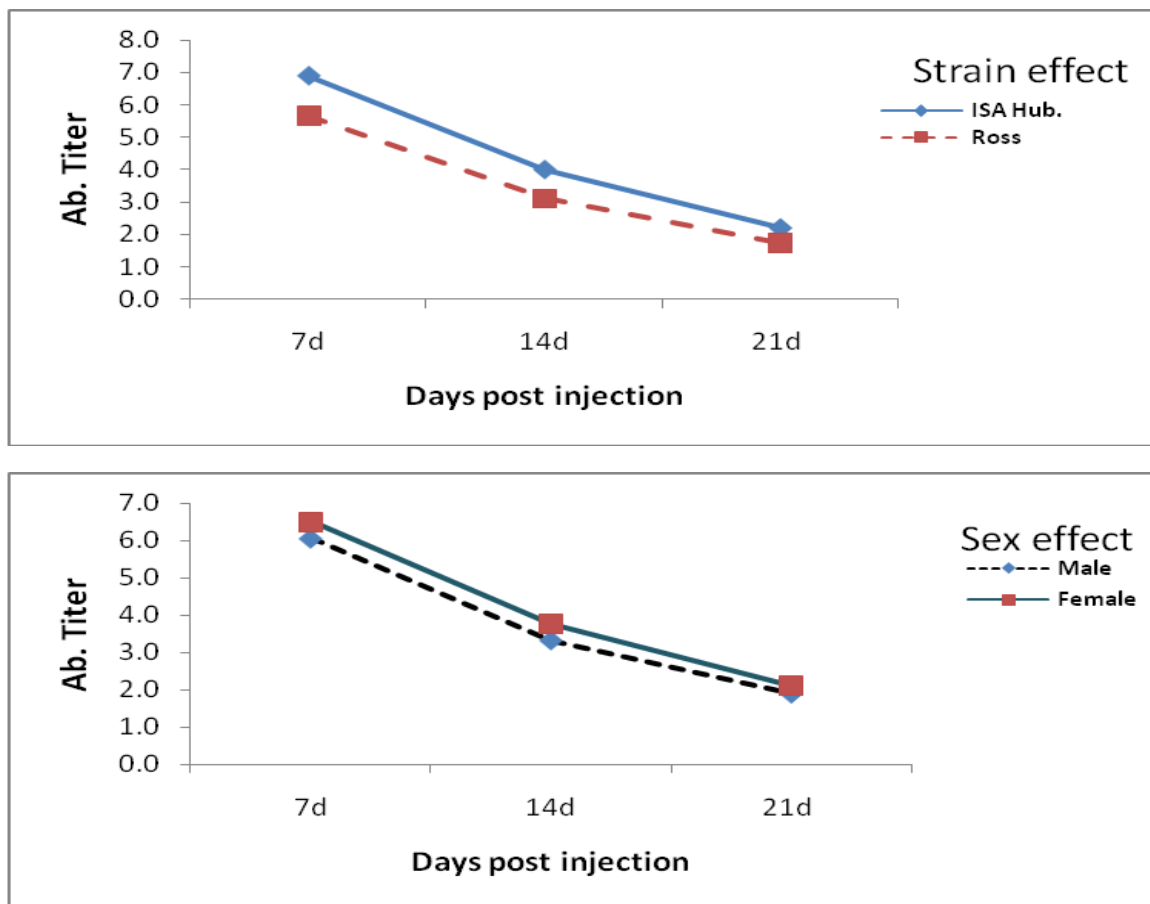


Fig.(1) Effect of both strain and sex on Ab titers at 7, 14 and 21-d post injection.

4. Phenotypic correlation between live body weight and antibody titer.

Results in Table (8) cleared that low and negative phenotypic correlations were obtained between antibody titers and live body weight at 7- wk of age. The negative phenotypic correlations may affect fitness sexes that can develop between the selected trait and correlated trait due to source in balance (Rendel, 1963). The

negative phenotypic correlation between growth and antibody response to SRBC_s has been demonstrated in several experimental lines of chickens (Marsteller *et al.*, 1980; Siegel *et al.*, 1982; and Van der zijpp *et al.*, 1988). This study stated that the genotypes with maximum body weight exhibit lower immunity.

Table (8): Phenotypic correlation between of antibody titer and live body weight at different ages in broiler chickens after injection with SRBCs.

Item	Antibody titer		Live body weight		
	Ab 14-d	Ab 21-d	5- wk	6- wk	7- wk
Ab 7-d	*** 0.506	*** 0.496	0.148	0.160	- 0.049
Ab 14-d		*** 0.669	0.188	0.188	- 0.008
Ab 21-d			0.196	0.193	- 0.041

*** = $P \leq 0.001$

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تأثير تفاعل السلالة والجنس ووزن الجسم الحي علي استجابة الأجسام المضادة لـ SRBCs في دجاج اللحم

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الملخص العربي

تم إجراء هذا البحث لتقييم تأثير كل من السلالة والجنس ضد انتيجين كرات الدم الحمراء للأغنام (SRBCs antigen) علي وزن الجسم الحي في دجاج اللحم عند أعمار مختلفة. إمتدت التجربة من يونيو إلي يوليو ٢٠٠٧ وعلي مدار دورة تربية واحدة من أجل معرفة العلاقة بين الاستجابة المناعية العامة للانتيجين SRBCs علي صفات وزن الجسم الحي لدجاج اللحم. تم استخدام اثنين من السلالات التجارية المختلفة (ايزا هابرد و روس 308). وتك تحضين وتربية الأفرخ تحت ظروف بيئية متماثلة حتي عمر التسويق (٧ أسابيع) كما زود الغذاء والماء حتي الشبع . تم تسجيل وزن الجسم الفردي لعدد ٥٠٠ فرخ (٢٥٠ من سلالة) عند أعمار ٠، ١، ٢، ٣، ٤، ٥، ٦، ٧ أسابيع . كما تم حقن لانتيجين المعد (ERBCs 25%) في جميع الطيور وبجرعة ٠.١٣ عند عمر ٢٨ يوم. أخذت عينات الدم من ويد الجناح وعلي أعمار ٧ و ١٤ و ٢١ يوم بعد الحقن وذلك لتقدير مستويات الأجسام المضادة بالدم . أعطت سلالة الأيزا هابرد متوسطات تتر – الجسم المضاد أعلي من الروس ٦.٩١ و ٥.٦٦ علي التوالي وذلك عند عمر ٧ أيام بعد الحقن . وكانت الفروق بين السلالات ($P \leq 0.001$) عالية المعنوية . في حين كان تتر- الجسم المضاد أعلي في الإناث من الذكور لكن دون اختلاف معنوي. وعلي الجانب الأخر أعطي تتر الجسم المضاد ارتباط مظهري سالب لكلا السلالتين عند أعمار ٧ و ١٤ و ٢١ يوم بعد الحقن وبقيم ٠.٠٤٩ و -٠.٠٠٨ و -٠.٠٤٢ علي التوالي.